California Energy Commission

COMMISSION REPORT

Electric Program Investment Charge 2018 Annual Report

California Energy Commission

Gavin Newsom, Governor

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California Energy Commission

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PREFACE

The California Energy Commission's Energy Research and Development Division supports energy research and development programs to spur innovation in energy efficiency, renewable energy and advanced clean generation, energy-related environmental protection, energy transmission and distribution and transportation.

In 2011, the Electric Program Investment Charge (EPIC) was established by the California Public Utilities Commission to fund public interest investments in applied research and development technology demonstration and deployment, and market facilitation of new and emerging energy solutions for the benefit of IOU electricity ratepayers. The California Energy Commission and the state's three largest investor-owned utilities—Pacific Gas and Electric Company, San Diego Gas & Electric Company and Southern California Edison Company—were selected to administer the EPIC funds and advance novel technologies, tools, and strategies that provide benefits to their electric ratepayers.

The Energy Commission is committed to ensuring public participation in its research and development that promote the EPIC program's identified ratepayer benefits of greater reliability, lower costs, and increased safety as well as EPIC's complementary guiding principles:

- Providing societal benefits.
- Greenhouse gas emissions mitigation and adaptation in the electricity sector at the lowest possible cost.
- Supporting California's loading order to meet energy needs first with energy efficiency and demand response, next with renewable energy (distributed generation and utility scale), and finally with clean, conventional electricity supply.
- Supporting low-emission vehicles and transportation.
- Providing economic development.
- Using ratepayer funds efficiently.

For more information about the Energy Research and Development Division, please visit the Energy Commission's website at www.energy.ca.gov/research/ or contact the Energy Commission at 916-327-1551.

ABSTRACT

The California Energy Commission is the state's primary energy policy and planning agency. As part of its overall mission, the Energy Commission administers several clean energy research and development programs that drive innovation and advance science and technology in the fields of energy efficiency, renewable energy and advanced clean energy generation, energy-related environmental protection, energy transmission and distribution, and transportation. The Energy Commission is one of the administrators of the state's Electric Program Investment Charge (EPIC) program. In administering EPIC, the Energy Commission funds investments in clean energy technologies and approaches that will benefit electricity ratepayers of California's three largest investor-owned utilities and lead to technological advancement and breakthroughs to overcome the barriers that prevent the achievement of the state's statutory energy goals. EPIC provides funding for applied research and development, technology demonstration and deployment, and market facilitation.

This report outlines the progress and status of Energy Commission activities funded by EPIC from January 1, 2018, through December 31, 2018. It has been prepared in accordance with applicable California Public Utilities Commission decisions and California Public Resources Code Section 25711.5.

Keywords: California Energy Commission, Electric Program Investment Charge, energy research, innovation pipeline, RD&D, energy efficiency, advanced generation, renewable energy, demand response, energy storage, buildings, distributed generation, transmission, smart grid, transportation, environmental, climate change, smart infrastructure, ratepayer benefits, public interest program, electricity, energy policy, loading order, jobs, greenhouse gas, California Public Utilities Commission

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Overview of Programs/Plan Highlights

California's electricity system supports the world's fifth largest economy. However, this system must evolve to meet the demands of the 21st century.

Over the past decade, California has made significant progress toward transforming its electricity system to meet these demands. While California's greenhouse gas emissions per person have declined about 23 percent from 2001 to 2016, the state's economy grew 41 percent from 2001 to 2016. In 2018, renewable generation accounted for an estimated 34 percent of retail electric sales, driven in large part by the rapidly declining cost of solar photovoltaic and wind generation technologies. These advancements have demonstrated the state's ability to transform its electricity system in a relatively short period and, in the process, provide California's leaders with the confidence to adopt even further-reaching energy and climate goals.

Despite this progress, today's energy technologies are insufficient to drive the scale of change needed to avoid the most serious impacts of climate change.

Scientific research funded by the California Energy Commission with contributions from utilities, the California Independent System Operator, federal agencies, state agencies, national laboratories, universities, and others has made it abundantly clear that the California energy system is vulnerable to climate impacts. An example of this research is an EPIC-funded study that assessed the impact of future heat waves to the power grid in Los Angeles County. This study found that the power grid in much of Los Angeles County faces capacity losses due to high temperatures while experiencing increases in peak hour loads even with aggressive energy efficiency measures. The most serious impacts of climate change are listed in *California's Fourth Climate Change Assessment (Fourth Assessment)* (Table ES-1).

Table ES-1: A Current and Qualitative Description of Current Understanding of Historical and Expected Climate Impacts in California

CLIMATE IMPACT	HISTORICAL TRENDS	FUTURE DIRECTION OF CHANGE	CONFIDENCE FOR FUTURE CHANGE
Temperature	Warming (last 100+ years)	Warming	Very High
Sea Levels	Rising (last 100+ years)	Rising	Very High
Snowpack	Declining (last 60+ years)	Declining	Very High
Annual Precipitation	No significant trends (last 100+ years)	Unknown	Low

Intensity of Heavy Precipitation Events	No significant trends (last 100 years)	Increasing	Medium-High
Frequency of Drought	No significant trends (last 100+ years)	Increasing	Medium-High
Frequency and Intensity of Santa Ana Winds	No significant trends (last 60+ years)	Unknown	Low
Marine Layer Clouds	Some downward trends; mostly not significant (last 60+ years)	Unknown	Low
Acres Burned by Wildfire	Increasing (last 30+ years)	Increasing	Medium-High

Source: *California's Fourth Climate Change Assessment*

For example, increases in ambient temperatures decrease the performance of thermal power plants, lower the performance and longevity of units such as transformers and distribution and transmissions lines, and significantly increase peak electricity demand for space cooling. Record breaking heat waves will be the expected norm (downtown Fresno, California is shown as an example in Table ES-2 below), where the number of extremely hot days has increased rapidly from what has been observed in the recent past. Consecutive extreme heat days (heat waves) will be longer, hotter, and more frequent (See Table ES-2 below). Furthermore, as the timing of extremely hot days will occur earlier and later in the year; the period for when space cooling is necessary will expand significantly. Climate change is also exacerbating the risk, severity, total area burned, and rate of spread of wildfires in California. These climate-related risk factors to the electricity system are the greatest public concern.

Table ES-2: Extreme Heat Days Exceeding 106.6°F per Year in Downtown Fresno, California

1961 – 2005	2050 – 2099	2050 – 2099
4	26 if greenhouse gas emissions are reduced at a moderate rate	43 if greenhouse gas emissions continue at current rates

Source: *California's Fourth Climate Change Assessment*

The pace of decarbonization in the electricity sector must ramp up considerably to meet the state's climate goals while adapting the energy system to climate change. Even with significant energy efficiency improvements, overall electricity consumption is expected to increase over the next few decades partly because of increased demand from climate change impacts. Electricity generation is the third largest source of greenhouse gases (after the transportation and industrial sectors), contributing about 16 percent of the state's overall emissions.

Using Electric Program Investment Charge (EPIC) funds, the Energy Commission has sponsored research on long-term energy scenarios that enable the energy sector to achieve the state's greenhouse gas reduction targets. Figure ES-1 (below) lists key greenhouse gas mitigation

strategies identified in a report prepared for the California Energy Commission by Energy + Environmental Economics.

Figure ES-1: Key GHG Mitigation Strategies

Deep Decarbonization in a High Renewables Future: Updated Results From the California PATHWAYS Model (The Pathways Study) identified 11 GHG mitigation strategies. EPIC addresses six of the items on the list, displayed in bold below:

1. **Building Energy Efficiency**
2. **Integration and Diversity of Renewable Electricity Resources**
3. Smart Growth That Reduces Light-Duty Vehicle Miles Traveled
4. Reducing Non-Energy GHGs and Short-Lived Climate Pollutants
5. **Deployment of Zero-Emission Light Duty Vehicles**
6. **Heat Pumps for Buildings and the Electrification of Other Building End Uses**
7. **Advanced and Sustainable Biofuels to Replace Liquid and Gaseous Fossil Fuels**
8. **Industrial Energy Efficiency and Electrification**
9. Solutions for Trucking and Freight Including Alternative-Fuel Trucks Along with Zero-Emission Trucks
10. Hydrogen as an Energy Carrier
11. Production of Climate-Neutral Fuels

Source: Mahone, Amber, Zachary Subin, et al., 2018. Deep Decarbonization in a High Renewables Future: Updated Results from the California PATHWAYS Model. California Energy Commission. Publication Number: CEC-500-2018-012

The Pathways Study discussed in Figure ES-1, which referenced previous research in this area including the 2013 report, *Deep Carbon Reductions In California Require Electrification and Integration Across Economic Sectors*, agrees that there are cost-effective paths to decarbonize power (electricity) generation, and that the decarbonization of electricity must be a priority. *The Pathways Study* evaluated long-term energy scenarios through 2050. These scenarios investigate options and costs for California in a changing climate to achieve a mandated 40 percent reduction in greenhouse gas (GHGs) emissions by 2030, and an 80 percent reduction in GHGs by 2050, relative to 1990 levels. *The Pathways Study* incorporates the results of an EPIC-funded University of California, Irvine study titled, *Translating Climate Change and Heating System Electrification Impacts on Building Energy Use to Future Greenhouse Gas Emissions and Electric Grid Capacity Requirements in California,* that provided the expected impacts of climate change on the electricity sector through 2050. Forecasted changes in the electricity sector through 2050 include a lower average availability of hydroelectric generation available to California and higher average temperatures, which result in lower heating demands in buildings and higher air-conditioning demands. The EPIC studies on long-term energy scenarios also strongly suggest that all energy services that can be electrified, such as the use of electric heat

pumps for space heating and electric passenger vehicles, must be electrified and that transition must start soon.

However, electrification will result in major changes of diurnal, monthly, and seasonal demand profiles. For example, electrifying space heating would result in new peak electricity loads in the winter. This change in demand profiles will also present new challenges and opportunities for California to meet and manage demand during those periods.

Meeting the state's climate goals while adapting the energy system to climate change, particularly by the decarbonization of electricity and electrification of energy services, will require novel ideas combined with innovative use strategies and informed decision-making to spur mass adoption of clean energy solutions that support a healthy environment and avoid potential unintended consequences. Through the EPIC program, the California Energy Commission has led in developing transformational technologies used in homes, businesses, farms, factories, and government agencies. For policy makers and other stakeholders, an important component of EPIC-funded research is to develop advanced analytical tools and scientific analysis to facilitate work by policymakers and other stakeholders to incorporate climate change into energy planning decisions. In a rapidly changing world, California's leadership is necessary now more than ever.

Building a Safe and Resilient Energy System

An aging electricity transmission and distribution infrastructure and a changing climate threaten the safety and resiliency of California's energy systems. Climate change impacts have led to significant increases in the frequency, size, and destructiveness of wildfires and other extreme weather events such as droughts. To address these and other challenges, the Energy Commission is supporting new scientific and technological advancements to equip California's stakeholders with the solutions necessary to build a safe and resilient energy system.

Incorporating Climate Science Into Energy Planning Decisions

California's electricity system is highly vulnerable to a variety of extreme weather events including droughts, heat waves, wildfires and flooding. Climate change will exacerbate many of these challenges and make resiliency a greater challenge. For policy makers and other stakeholders, making informed decisions can be challenging without more sophisticated analytical tools and scientific analysis capable of evaluating the complexities and implications of different strategies.

Energy Commission EPIC funded research contributed projections to *the Fourth Assessment* to inform climate-related risks and resilience options for the electricity sector. Released on August 27, 2018, the *Fourth Assessment* was a multisector, interagency effort designed to appraise policies, plans, programs, and guidance to safeguard California from the effects of climate change. The compilation of original research on climate change impacts will help the state prepare for a future punctuated by severe wildfires, more frequent and longer droughts, reduced snowpack, rising sea levels, increased flooding, coastal erosion, and extreme heat. The research translates global models into scaled-down, regionally relevant reports to fill information gaps and support decisions at the local, regional, and state levels.

While research from the *Fourth Assessment* focused on California-based scenarios and energy infrastructure, California research can lead the way by informing efforts in other states and countries to reduce their emissions as well. In turn, progress made in the rest of the United States and the world in emission reductions can mitigate the temperature impacts discussed earlier.

Underpinning the *Fourth Assessment* are climate and sea-level-rise scenarios that resulted from EPIC-funded research. The scenarios developed under this EPIC-funded project include the following: annual average maximum temperature, minimum temperature, and precipitation; extreme heat; sea-level rise; snowpack; wildfire; cooling degree days and heating degree days; streamflow; and extended drought. These data are available to the public from Cal-Adapt.org. An Energy Adaptation Working Group, initiated by former Energy Commission Chair Robert B. Weisenmiller and California Public Utilities Commission (CPUC) Commissioner Liane M. Randolph, recommended that California formalize consistent scenarios and science-driven decision-making. The Energy Adaptation Working Group also includes representatives from the Office of Planning and Research, California Natural Resources Agency, and the Governor's Office of Emergency Services. In turn, these scenarios determined if the vulnerabilities of the energy system to climate change would undermine California's ability to achieve mid-century emissions reductions goals. The long-term energy scenario studies concluded that the impacts of climate change to the energy system would not thwart California's efforts to reduce GHG emissions and there are multiple ways to reduce GHG emissions from the electricity system and the energy system in general.

The data and technical reports contributing to the energy sector portion of the *Fourth Assessment* are being used to support the California Public Utilities Commission's (CPUC) ongoing rulemaking to Consider Strategies and Guidance for Climate Change Adaptation (CPUC Rulemaking #18-04-019). Specifically, the EPIC-funded research contributing to the *Fourth Assessment* will support the CPUC's working groups regarding data sources, models, and tools; guidelines for assessment and planning; and adaptation decision-making under uncertainty. To foster knowledge transfer of EPIC research results in support of this rulemaking, a series of Energy Adaptation Webinars highlighting *Fourth Assessment* contributions is underway. CPUC staff, utilities, and other energy sector stakeholders have been attending these informational webinars, which provide an opportunity for staff training, as well as direct exchange between experienced technical experts, policymakers, and the research community. The webinars have received significant attention, with some having over 100 people in attendance.

Maintaining Critical Operations and Services During Wildfires

Wildfires and other natural disasters have highlighted the necessity for new technology solutions capable of maintaining power to critical operations and services during electric grid outages. Microgrids are a new solution that allows for continued operation during a grid outage, using on-site renewable generation and energy storage instead of diesel generators. However, widespread deployment of microgrids has been limited by several factors including cost and concerns regarding the sophisticated control systems that must respond quickly and reliably during a grid outage.

> An estimated 15 to 20 percent of the [Blue Lake Rancheria Microgrid] project costs were associated with the first-of-its-kind, research and development nature of the project.

In 2015, the Energy Commission provided EPIC funding to the Blue Lake Rancheria community to install and demonstrate a campus microgrid capable of providing power to the local American Red Cross evacuation center in Humboldt County. The authors of a report on a community microgrid in Humboldt County wrote, "While microgrid controller technology has matured beyond the research and development phase, systems must be demonstrated at a larger scale to prove the capabilities and move the technology toward full commercialization." Shortly after being installed and commissioned, the Blue Lake Rancheria microgrid was put to the test. On October 8, 2017, a wildfire started about a quarter mile from the Blue Lake Rancheria campus, causing a power outage from 4:37 p.m. until 5:55 p.m., and leaving nearly 1,900 customers without power. During this time, fire crews used the Blue Lake Rancheria campus as an emergency response and staging center, avoiding a loss of power that could have significantly hampered firefighting operations. The microgrid detected the outage, automatically islanded (isolated) itself from the statewide grid, and prevented a blackout to the Blue Lake Rancheria campus. At 5:55 p.m., the microgrid automatically reconnected to the grid when power was restored. The response of the microgrid to the power outage was so quick and seamless, the outage went unnoticed by the Blue Lake Rancheria campus until the operational logs were reviewed. The successful performance of the Blue Lake Rancheria microgrid in an actual emergency provides further evidence that microgrid technology can play a key role in building a more resilient electricity system. The Blue Lake Rancheria microgrid received the Federal Emergency Management Agency's 2017 Whole Community Preparedness Award and POWERGRID's International Project of the Year (2018) award for Distributed Energy Resource (DER) Integration, marking the first time that a non-utility has won the award. Furthermore, the technological learning from this project can be applied to reduce the cost of future microgrid installations.

Minimizing the Impacts of the Drought on California's Food and Beverage Sector

Droughts are expected to become the norm under climate change and present a significant challenge to the economic competitiveness of California's food and beverage manufacturing sector. In addition to water shortages, these factories face increasing costs to treat and discharge the wastewater that results from manufacturing operations. One option is to treat the wastewater for onsite reuse. However, conventional technologies are often expensive, energy intensive or unable to treat the wastewater to the purity levels needed for onsite reuse.

In 2015, the Energy Commission awarded EPIC funding to San Leandro-based **Porifera, Inc.** to conduct pilot demonstrations of its Porifera Forward Osmosis (PFO) Recycler at beverage manufacturing plants. The core innovation in the PFO recycler is a new type of forward osmosis technology that overcomes the limitations of current forward osmosis products on the market, such as the capital cost and bulkiness. At Jackson Family Wines in Sonoma County, one of the

pilot demonstration sites, the PFO Recycler reduced the energy required to treat the industrial wastewater by 15 percent to 30 percent while recovering 80 percent of the wastewater for reuse onsite, including the irrigation of its grapes (Figure ES-2). Following the pilot demonstration, Jackson Family Wines entered into negotiations with Porifera in 2018 to install a commercial system at one of its wineries.

Figure ES-2: Water Purity Testing at Jackson Family Wines With (top) and Without (bottom) the PFO Recycler

Credit: Porifera

Improving the Affordability, Health, and Comfort of California's Communities

Energy plays a critical role in the affordability, health, and comfort of California's residential customers and the communities they live in. Increasing the capacity for communities to generate local renewable energy reduces the demand for fossil fuel generation and helps reduce greenhouse gas emissions. Similarly, advances in energy efficiency technologies can not only save residents' money, but can also increase the comfort of homes by more efficiently controlling heating and cooling.

Bringing New Clean Energy Technology Solutions and Related Benefits to Disadvantaged and Low-Income Communities

Bringing energy savings programs to low-income customers has programmatic and structural challenges. Participation for residential customers may entail high upfront costs for automation technology or be contingent on owning, not renting, their home. In 2016, the Energy Commission provided EPIC funding to San Francisco- and Campbell-based **OhmConnect** to improve the accessibility of demand response programs to residential customers, including low-income customers and renters. One of the findings is that there are concentrations of reliable, high-performing customers—that is, customers who almost always reduce their loads by a substantial amount—in areas designated as Disadvantaged Communities. While the

company does not collect income or other demographic information on their customers, voluntary feedback through the platform—as in written responses to messages such as "Tell us how you're saving!"—suggest that these participants are motivated by the cash rewards.

To participate in OhmConnect's service, only a cellular phone that could receive text messages is required- which opens the door to electricity customers who can't afford energy efficiency upgrades or to customers who rent their homes. OhmConnect bids demand response into California Independent System Operator's wholesale capacity market in the form of commitments to provide an amount of demand reduction over a specified amount of time—typically one hour. OhmConnect's interface platform engages customers through a variety of digital mediums and encourages participation in load reduction events, which are called by OhmConnect to coincide with California ISO-related opportunities for cost savings. Text messages, emails, or social media such as Twitter or Instagram alert users when they should conserve electricity. OhmConnect rewards customers, based on their use reductions, with points that can be converted into cash or gift cards. To generate revenue, OhmConnect then sells the aggregated hourly load reductions into the California ISO's wholesale capacity market through the Demand Response Auction Mechanism (DRAM) program.

OhmConnect's data collection and processing technology accumulates and aggregates customer meter data, documents performance, and verifies the load-reduction "product" being sold into the market. As OhmConnect grows its subscribers, it grows its ability to assemble cohorts of customers to reduce loads also expands, which could make demand response by smaller customers a viable option for ancillary markets traditionally served by fossil generation and other expensive resources. While OhmConnect's prices for aggregated hourly load reductions sold to the California ISO are confidential, OhmConnect claims that the prices that they will receive for reduced megawatts in the SDG&E service territory are less expensive than the generation procured from storage facilities who the utility contracted with in 2017.

Reducing Energy Costs of Municipal Wastewater Operations Provided to Communities

Budget and resource constraints, combined with environmental and public health concerns, are challenging the ability of municipalities to manage wastewater in their jurisdictions without large electricity rate increases. Energy is a major operating expense for wastewater treatment plants. One of the biggest opportunities to reduce energy use in wastewater treatment plants is to remove large quantities of organic material in the primary treatment before the wastewater enters the energy-intensive secondary biological treatment process.

A little over two-years after being awarded EPIC funds, OhmConnect has grown its number of subscribers to 400,000 as of December, 2018.

In 2015, the Energy Commission provided EPIC funding to Kennedy-Jenks to demonstrate a new technology for the primary treatment process. This new technology, called *pile cloth depth filtration*, filters 75 to 85 percent of the suspended solids and 50 to 60 percent of the organics before secondary treatment.

The filtered organics are then sent to the on-site digester for increased biogas production. The facility uses the biogas to meet its heating needs.

As part of the Energy Commission's funding award, Kennedy-Jenks demonstrated the pile cloth depth filtration technology at the Linda Wastewater Treatment Plant in Yuba County and at the Lancaster Water Reclamation plant in Los Angeles County. Compared to the conventional primary treatment method, the pile cloth filtration method resulted in a 25 to 30 percent reduction in electricity demand required for aeration in secondary treatment. This technology also resulted in a 30 to 40 percent increase in biogas energy production in the anaerobic digestion due to the high organic energy content of the solids removed by the filter.

Technology Solutions to Meet the Needs of Rural Communities

Rural communities often experience energy reliability issues since they may be located at the end of electric transmission lines. Areas that lack natural gas service are especially vulnerable and may rely on expensive propane systems, wood, electric resistance heating, or inefficient heat pumps. In 2015, the Energy Commission awarded EPIC funding to the Sierra Institute for Community and Environment to demonstrate a new type of organic Rankine cycle generator paired with a boiler to provide onsite power and heat to the Plumas County Health and Human Services Center in Quincy, California.

The organic Rankine cycle generator, which runs on captured heat from a boiler, provides a more robust and reliable solution to generate electricity from forest biomass when compared to traditional steam turbines. In addition, the organic Rankine cycle generator can be integrated with the existing heat pump system of the building to provide adequate space heating and reduce the use of electric space heaters in the building. The system was installed and commissioned in the first and second quarters of 2018. The heat, power, and economic performance of the system will be fully evaluated and tested in the 2018-19 winter season, when heating demand is high. The advantage of the system is that it could provide heat and power using biomass fuel without the massive footprint, fuel requirements, and staffing required of a central station biomass power plant. A central station biomass power plant may be too big to meet small loads in rural communities. While the 10 MW biomass below has an 18-acre footprint, the modular system is sized 8 feet by 8 feet by 7 feet (Figure ES-3).

Figure ES-3: Footprint of 35 kW Electratherm Organic Rankine Cycle Generator Compared to 10 Megawatt Biomass Plant in Colorado

Credit: Electratherm

Credit: Evergreen Clean Energy

Supporting California's Local Economies and Businesses

California is the fifth largest economy in the world. California's energy sector is a vital contributor to providing the necessary goods, products, and services that have helped achieve that status. Furthermore, the global, national, and regional markets for clean energy are creating new economic opportunities for California's technology companies and entrepreneurs. To maintain California's global competitiveness and leadership in low-carbon opportunities, the Energy Commission is supporting California's businesses in their efforts to develop and adopt the next generation of clean energy technology solutions.

Bringing Internet of Things (IoT) Solutions to California's Industrial and Agricultural Sectors

California's agricultural and industrial sectors are critical to the state's economy. Historically, these sectors have lacked scalable technology solutions to help them reduce electricity use. Through EPIC, the Energy Commission has helped two companies conduct successful field trials of data analytics platforms specifically designed for industry and agriculture. These platforms utilize Internet of Things (IoT) solutions. The term IoT is used to describe devices that wouldn't usually be generally expected to have an internet connection, and that can communicate with the network independently of human action. These include lightbulbs that could be switched on using a smartphone application and smart thermostats.

The Energy Commission provided EPIC funding to a company called **Lightapp** in 2015 to undertake a large-scale evaluation and demonstration of its data analytics platform for compressed air systems. Air compressors play an invaluable role in industrial processes, powering everything from bottling lines at breweries to power tools in automotive factories. Lightapp's system was demonstrated in 51 manufacturing facilities in California, including the Pepsi plant in Fresno and Bimbo Bakery in Montebello (Los Angeles County). For the facilities that have been analyzed so far, annualized energy cost savings is estimated to exceed $800,000.

Through 2018, start-up companies in the program have attracted $64 million in private investment, and $24 million in public funding. Additionally, the organizations that make-up the California Energy Innovation Ecosystem have used their Energy Commission funding to attract $4.4 million in federal funding to expand the services they provide to entrepreneurs within the state.

Based on these findings, if the technology were deployed by all industrial facilities that use significant compressed air, savings could reach $16.5 million per year.

In addition to the industrial sector, IoT can provide potential energy- and water-saving applications for the agricultural sector. In 2015, the Energy Commission awarded EPIC funds to the San Mateo-based startup, **PowWow Energy**, to conduct field trials of its software platform that helps farmers improve irrigation scheduling based on ground moisture, electric rate schedules, and other inputs. The field trials occurred at six commercial farming sites in the Sacramento and San Joaquin Valleys. Given the same level of crop production, energy savings between 9 to 31 percent were observed from pump monitoring and irrigation optimization, with an average improvement in energy efficiency (energy savings for the same level of crop production) of 13 percent across an irrigation system. Water-use efficiency for the same level of yield also improved 9 percent across a variety of crops, including alfalfa, almond, pistachio, and tomato).

Building a Statewide Ecosystem to Support Clean Energy Entrepreneurship

In 2013, a year before the Energy Commission made its first EPIC awards, private sector investors had largely withdrawn from the cleantech sector. Per a July 2016 MIT Energy Initiative paper, *Venture Capital and Cleantech: The Wrong Model for Clean Energy Innovation*, venture capital investment had dropped to $2 billion, down from $5 billion in 2008, after investors learned through firsthand experience that new energy technologies have longer development timelines and higher capital requirements than software start-up ventures. Because of the decline in private investment, a number of studies and organizations identified the need to reimagine the existing model for delivering clean energy technologies to the market.

In 2016, to foster and support clean energy entrepreneurship across the state, the Energy Commission launched the first phase of the California Energy Innovation Ecosystem, a statewide network of technology incubators, investors, universities, non-profits and corporate partners. As part of this initial phase, the Energy Commission re-established a small grant program called CalSEED to provide proof-of-concept funding for new technology ideas. To complement CalSEED, the Energy Commission also established four regional innovation clusters that collectively provide entrepreneurial support services —such as laboratory equipment and buildings, business plan development, and connections to investors —throughout the state. Each cluster evaluates start-up companies within their respective regions and, if accepted, designs an entrepreneurial assistance and mentorship program that leverages the region's universities and research institutions, industries, businesses, economic development organizations, and other key regional stakeholder groups. This guidance helps clean energy

entrepreneurs focus limited time and resources on the most critical activities for developing their technology and business.

Creating New Solutions of Energy Efficiency in Commercial Buildings

Many commercial buildings face high energy bills, unpredictable and expensive equipment upkeep costs, and reactive maintenance because building managers are often not equipped with the real-time, proactive information necessary to properly maintain the heating, ventilation, and air-conditioning (HVAC) equipment. While building energy management products exist for the large commercial building market, few technology products exist for small- and medium-sized commercial buildings.

Accordingly, the Energy Commission provided EPIC funds, via a CalSEED grant, to **Enerdapt**, a startup based in the Sacramento County community of McClellan Park. With CalSEED funding, Enerdapt completed a proof of concept and two real case studies of HVAC energy savings. Enerdapt uses software and artificial intelligence to control the climate in office buildings more efficiently. Its software also applies machine-learning algorithms to improve the performance and life of the HVAC systems, using data from existing sensors to quantify and automatically optimize system operations. The system uses the existing sensors, thermostats, and controls of a building but employs analytics at a data center to make the best decisions for the system in real time. Enerdapt's platform provides building managers with information on potential failures in the building's energy hardware, the estimated payback for the repair, and a suggested priority rating.

The artificial intelligence that performs the real-time energy management allows Enerdapt to keep costs down and offer installation of the service for $3,100. Enerdapt's service can reduce the energy operating costs of a building by 20 to 30 percent for an estimated payback time of five months. From its EPIC-funded case studies, Enerdapt found that using its product demonstrated 45 percent HVAC energy savings while reducing service calls and unit degradation. Ninety percent of Enerdapt's buildings are between 40,000 and 160,000 square feet, buildings that consume significant amounts of energy but are not large enough to employ an on-site building engineer to monitor energy use.

Enabling a More Decarbonized and Decentralized Electric Grid

California's energy and climate change policy goals envision a significantly more decarbonized and decentralized electric grid than the currently existing infrastructure developed a century ago. For California to meet these goals, innovations are needed that can 1) drive cost reductions in renewable energy generation and 2) increase the use of low-carbon resources to provide grid flexibility and stability.

Addressing Product Gaps in the Energy Storage Market

The rapid growth of intermittent renewable energy sources like photovoltaic solar and wind generation is driving the need for cost-effective energy storage. Lithium-ion batteries are the market leader in energy storage technologies, due in large part by the growth of consumer electronics and electric vehicle markets. However, lithium-ion batteries may not be optimally

suited for larger-scale energy storage applications. Furthermore, lithium-ion batteries rely on materials that may have future supply chain issues including concerns as to whether the supply of cobalt and lithium, metals that compose these batteries., can meet the expected global demand for energy storage. To address gaps in the energy storage space, the Energy Commission is investing in alternative storage technologies.

The Energy Commission provided EPIC funds in 2016 to **Eos Energy Storage, LLC (Eos)** to develop and test a zinc-hybrid cathode battery that uses -abundant, lower-cost, and non-toxic materials. With the EPIC funds, Eos is pilot testing a system to characterize a variety of use cases, including peak shaving, ancillary services, load following, and frequency regulation. Eos is the only non lithium-ion energy storage technology that was selected as the battery supplier for a 10-megawatt (MW)/40 megawatt-hour (MWh) energy storage services agreement between Pacific Gas and Electric Company (PG&E) and developer Convergent Energy + Power. This demonstration will provide information and data to assess the value and cost savings of utility-scale battery energy storage when interconnected to the grid. This information will help utilities evaluate Eos and other non-lithium-ion battery technologies for future storage procurement decisions.

In 2017, EOS became the first company to accept orders below $100 per usable kilowatt-hour (kWh) for a complete direct current (DC) battery system.

In September 2017, Eos announced the hiring of four executives to support the manufacturing and launch of the company's utility-scale energy storage solution. Included among the hires is a vice president of manufacturing, who served as executive director of battery operations for Apple, along with other executives whose energy experience includes work at ABB and Iberdrola Renewables. In 2017, Eos became the first company to accept orders below $100 per usable kilowatt-hour (kWh) for a complete direct current (DC) battery system including battery modules, battery management system, and outdoor-rated enclosure.

Using Big Data to Improve Grid Operations

Alongside advanced storage technologies, developments in solar energy forecasting can further improve the economics of solar energy generation. Forecasting can help solar power plants with energy market imbalance charges for overscheduling or underscheduling generation. Improved forecasting may also lessen the need to have costly capacity from high-emission peaking power plants on standby.

Furthermore, the Energy Commission awarded EPIC funds to the University of California, San Diego in 2015 to test alternatives to California ISO's centralized solar forecasting for the California Valley Solar Ranch (CVSR) plant. To support CVSR's development of alternative forecasts, the research team developed a low-cost, autonomous and wireless sensor that can be used easily over a large solar field to monitor irradiance. The team collaborated with representatives of CVSR to test the sensors in a real-case scenario. The sensors collected high

quality data and demonstrated their capacity to be installed at any solar farm to supplement local data acquisition, which often is limited to few sensors.

Using the radiance data gathered from the sensor developed under this project, the team developed an alternative forecasting method and compared it to California ISO's centralized solar forecasting for CVSR. This customized solution for CVSR resulted in forecasts that substantially reduce the net imbalances relative to the centralized California ISO's forecast. The alternative to the California ISO's forecasts created were found to be more accurate. Based on the timeframe, the accuracy of forecasts of solar irradiance improved by as little as 10 percent for the intra-hour forecast to as high as 62.4 percent for the day ahead forecast.

From 2016-18, researchers used the algorithms and tools developed for the 300 MW, 3,500 acre Ivanpah Solar Electric Generating System in the Mojave Desert and CVSR to predict the power generation of two medium-size (1 MW) photovoltaic (PV) installations in Southern California-Canyon Crest Academy in San Diego and La Costa Canyon in Carlsbad.

Reducing the Cost of Renewable Generation

The declining cost of PV generation technologies has been one of the energy sector's biggest success stories of the past decade. Despite this progress, further cost reductions are required to accelerate the growth of the PV market. Tracker systems that follow the sun's path could significantly improve the economics of PV generation over traditional fixed-tilt system. However, many PV trackers rely on motors and gearboxes with hundreds of moving parts and wear surfaces coupled to heavy steel structures, and thus, have higher installation, operation, and maintenance costs compared to the fixed-tilt counterparts.

In 2015, the Energy Commission awarded EPIC funds to a San Francisco-based start-up company called **Sunfolding** to conduct a field validation of its AirDrive™ PV tracking system. The AirDrive™ PV tracking system uses robust and reliable air-based components instead of mechanical components to track the sun throughout the day (Figure ES-4). As part of the Energy Commission award, Sunfolding tested its system against three critical metrics for tracker systems: tracker accuracy, component failure, and availability. The system passed the validation on all three metrics. With the EPIC funds, Sunfolding was able to move its tracker from a basic prototype tested in the lab to a 300kW field demonstration without significant design problems. This system has the potential to reduce structural components by 10 times, resulting in cost savings on multiple fronts including a 65 percent reduction in labor hours for installation, a 7 percent reduction in operation and maintenance costs, and a 3 percent reduction in the levelized cost of electricity from PV.

Figure ES-4: Sunfolding's Tracking System

Source: Sunfolding

These test results have helped Sunfolding make the first sales of the AirDrive™ technology in 2018 for a 3 MW project at 12 agricultural sites in Madera and Fresno Counties which are part of the Solar Alliance energy cooperative. The PV systems in this project are used for lighting, water pumps, irrigation, and other high-energy-use systems.

Advancing Low-Carbon Transportation Technologies

Transportation electrification is a key strategy to decarbonizing California's energy sector while providing significant reductions in air pollutants that impact public health, especially in the state's nonattainment areas. A nonattainment area is an area designated by the California Air Resources Board (CARB) as having at least one violation of air quality standards in the past three years. A violation is an instance in which there is an excess amount of ten criteria pollutants in the air relative to the state standard (this doesn't count air pollution that's the result of an exceptional event such as a wildfire or dust storm). Despite the environmental and public health benefits of electric vehicles, the cost of ownership serves a barrier to market penetration. To reduce the cost of electric vehicle ownership, new technology advancements are needed.

Reducing Electric Vehicle Fueling Costs Through Vehicle-Grid Integration Technology Advancements

One of the key advantages electric vehicles have over the conventional petroleum counterparts is the associated lower fueling costs. However, this advantage depends largely depends on the price of electricity, which corresponds with the time of day electric vehicle owners charge their vehicles. As electric vehicles move beyond the early adopter market to the mainstream market, technology solutions are needed that can provide seamless and automated smart charging for electric vehicle owners.

The Energy Commission provided EPIC funds to **ChargePoint Inc**. to evaluate the functionality and consumer acceptance of advanced communication technologies that can optimize electric

During this pilot demonstration, drivers realized a 45 percent reduction in their charging cost when using the managed charging schedule, which resulted in an average $467 annual savings.

vehicle charging to balance grid conditions while meeting driver mobility needs. As part of this project, ChargePoint integrated the International Organization for Standardization/International Electrotechnical Commission 15118 advanced communication standard into its residential charging stations to transmit smart charging features such as grid conditions, driver preferences, and battery pack state-of-charge information.

ChargePoint then conducted a 3-month, two-phase pilot project with thirty residential electric vehicle owners. During Phase 1, ChargePoint collected data on the driver's charging behavior, which ChargePoint used in Phase 2 to send controlled charging schedules to the vehicles. The majority of the participants (27 drivers) participated in the two-month controlled charging program during Phase 2. The 27 drivers who participated saw their original charging costs decline from 28.62¢/kWh in Phase 1 to 15.64¢/kWh in Phase 2. In addition to the reduced costs, the controlled charging strategy enabled the drivers to complete all of their charging needs with minimal behavior change.

Improving the Safety and Cost of Electric Vehicle Batteries

Widespread electric vehicle adoption has been limited by the cost, weight, and capacity of the battery pack. Lithium-ion (li-metal) batteries used in electric vehicles have made significant cost and performance improvements over the past several years. However, today's lithium-ion batteries use a graphite cathode that limits the energy density of the battery pack. Replacing the graphite cathode with a lithium-metal cathode has the potential to increase significantly the energy density of the battery packs and enable electric vehicles with a 400-mile range. Despite the potential benefits, lithium metal anode batteries have manufacturing, flammability, and durability issues that must be resolved before they become commercially available.

The Energy Commission is addressing technical challenges to lithium-metal batteries and the requirements of electric vehicle manufacturers through its CalSEED Initiative and funding for Cyclotron Road, a Bay Area technology incubator. EPIC funds have supported lithium metal battery technology developers **Cuberg, Inc.** and **Sepion Technologies**. Cuberg's technology replaces the traditional battery cathode chemistry with a safe and stable blend of non-flammable solvents and salts. Cuberg Inc. has received recent seed funding by Boeing and the U.S. Army, and is exploring ways to scale up production within the next year.

Sepion Technologies is developing a membrane to protect lithium metal anode batteries from crystalline (dendrite) growth at a fraction of the cost of the current ceramic-based protection method. Sepion Technology's technology can be mass-produced using roll-to-roll manufacturing, thereby reducing the risk, time, and cost to integrate the membrane into the larger battery manufacturing process.

In 2018 Sepion Technologies was one of four companies selected to receive $450,000 in a subsequent funding award from the CalSEED Initiative.

Status of EPIC Program

Since its inception and first award, EPIC has filled an important gap in the California clean energy policy space, providing the technology push to complement the state's market pull policies. Market pull policies are measures including the Renewable Portfolio Standard that create market signals for clean energy technologies as opposed to technology push policies such as the EPIC program, which advances research, development, and demonstration to drive further technical and cost performance of clean energy technologies. The Energy Commission began implementing EPIC in 2014, following the CPUC's approval of the 2012-2014 EPIC Investment Plan and the passing of Senate Bill 96 (SB 96) (Committee on Budget and Fiscal Review, Chapter 356, Statutes of 2013). The Energy Commission developed a twofold strategy to maximize EPIC's effect, reflecting the policy and economic environment at the time.

The first part of the EPIC strategy was to accelerate technological learning, "learning-by-doing" or "learning-through-implementation," of key emerging technology categories vital to a modernized grid. State policies targeted the 2020 timeframe as a critical milestone in California's pursuit of a low-carbon future. California researchers and technology companies had developed new technology solutions with the potential to realize these 2020 goals. However, many of the professions responsible for their use —including permitting agencies, architecture and construction firms, installers, equipment operators, and end-use customers — were unfamiliar with how to plan, select, install and operate those new solutions.

To accelerate the necessary technological learning, the Energy Commission focused early EPIC investments on demonstration projects that address gaps in the deployment-specific knowledge and skills needed to move solutions from controlled laboratory settings to real-world installation and operating conditions. This included targeted funding opportunities for demonstration projects around key technology topics such as energy storage, microgrids, and low-carbon buildings. In addition, the Energy Commission provided funding to develop and update tools that streamline the use of these new technologies in existing buildings, regulatory frameworks, and electric infrastructure. With the first wave of EPIC projects coming to completion, the Energy Commission is ramping up its technology transfer activities to ensure the technological learning gained from these projects reaches the stakeholders involved in the deployment and the use of these technologies.

The second part of the Energy Commission's EPIC strategy was to develop and implement a new model for supporting new clean energy technology ventures that could meet the requirements of the private sector. In 2016, the Energy Commission launched this new model, *California Energy Innovation Ecosystem* to:

1. Build the human and digital infrastructure, and networks necessary to support clean energy entrepreneurship across the state.
2. Create a more streamlined framework for developing and commercializing new energy technologies.

3. Leverage California's existing capacity—including universities, national labs, technology companies, and nonprofits—to support new clean energy ventures.

In 2018, the Energy Commission launched the second phase of C*alifornia Energy Innovation Ecosystem* to fill additional gaps in the statewide innovation ecosystem. As part of this second phase, the Energy Commission used EPIC funds to establish a new program called CalTestBed to provide start-up companies with access to the state's premier testing and certification laboratories, as well as access to technical services such as product validation and technical feedback on design. Start-up companies that are selected receive a voucher that they can bring to one of the eligible centers to test the design, safety and performance of their prototype to refine and meet customer specifications.

In addition to CalTestBed, in 2018, the Energy Commission used EPIC funds to establish a new incubator program specifically focused on assisting and training energy start-up companies as they apply to formal procurement opportunities offered through federal and state agencies, as well as and other institutional organizations such as hospitals, schools and municipal offices. Also in 2018, the Energy Commission successfully piloted a new mechanism called *Bringing Rapid Innovation to Green Energy* (BRIDGE) to competitively award subsequent funding for the most promising technologies that had previously received funding for early-stage development from an eligible federal agency or one of the Energy Commission's research programs. BRIDGE helps start-up companies avoid the funding gap between the time a successful project ends and funding for new projects is awarded, a process that can span two to three years.

In late 2018, the Energy Commission issued a new funding opportunity using EPIC funds to address the "Market Expansion Valley of Death" called *Realizing Accelerated Manufacturing and Production*. This program provides technical and financial assistance to help clean energy entrepreneurs successfully advance their emerging best-of-class innovative technologies to the low-rate initial production stage. Low-rate initial production is the first step in transitioning from highly customized hand-built prototypes, which are used for pilot testing and vetting with customers, to the final mass-produced product.

Looking Ahead

The deadly and destructive fires of the past few years as well as findings from *(Fourth Assessment)* have highlighted the dire impacts expected from climate change on California and its electric ratepayers if greenhouse gas emissions are not drastically reduced. Key policies adopted in 2018 – including SB 100 and then-Governor Edmund G. Brown Jr.'s Executive Order B-55-18 call for an accelerated timeline for California to fully decarbonize its energy sector. In the state's transition to a low-carbon economy, California's leaders have made equity a policy priority. Meeting these goals and accelerating the pace and scale of adoption at a global scale will require successful development and commercialization of breakthrough advancements that drive down the capital costs of clean energy technology solutions.

California — with its world-class universities, national laboratories, technology, private-public partnerships and entrepreneurial spirit — has tremendous capacity to deliver these technology

advancements. The Energy Commission, through its *California Energy Innovation Ecosystem Initiative,* has been putting the infrastructure in place to mobilize this capacity effectively and efficiently around energy technology breakthroughs and entrepreneurship. With this infrastructure in place and California's policies calling for an accelerated timeline to combat climate change, the Energy Commission, under the 2018—2020 Investment Plan, is emphasizing the development and commercialization of breakthrough energy technologies.

CHAPTER 1:
Introduction and Overview

This chapter includes information about the portion of the Electric Program Investment Charge (EPIC) program administered by the California Energy Commission and highlights specific actions and activities from 2018.

Background on EPIC

The California Public Utilities Commission (CPUC) established EPIC to fund public investments in research that create and advance new energy solutions, foster regional innovation, and bring ideas from the lab to the marketplace. The California Energy Commission along with the state's three largest investor-owned electric utilities — Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company — were selected to administer the EPIC funds.

The Energy Commission's administration of EPIC is in line with best practices for public research programs, and this administration was commended in 2017 as part of an independent evaluation of the EPIC program directed by the CPUC. The independent evaluation also verified the Energy Commission administers EPIC through a fair and transparent process so that no one entity has an unfair advantage or receives preferential treatment. In addition, the Energy Commission has developed additional strategies and activities to ensure that its administration of EPIC provides the greatest impact to electric ratepayers. A brief description of some of these strategies and activities are discussed in the following sections.

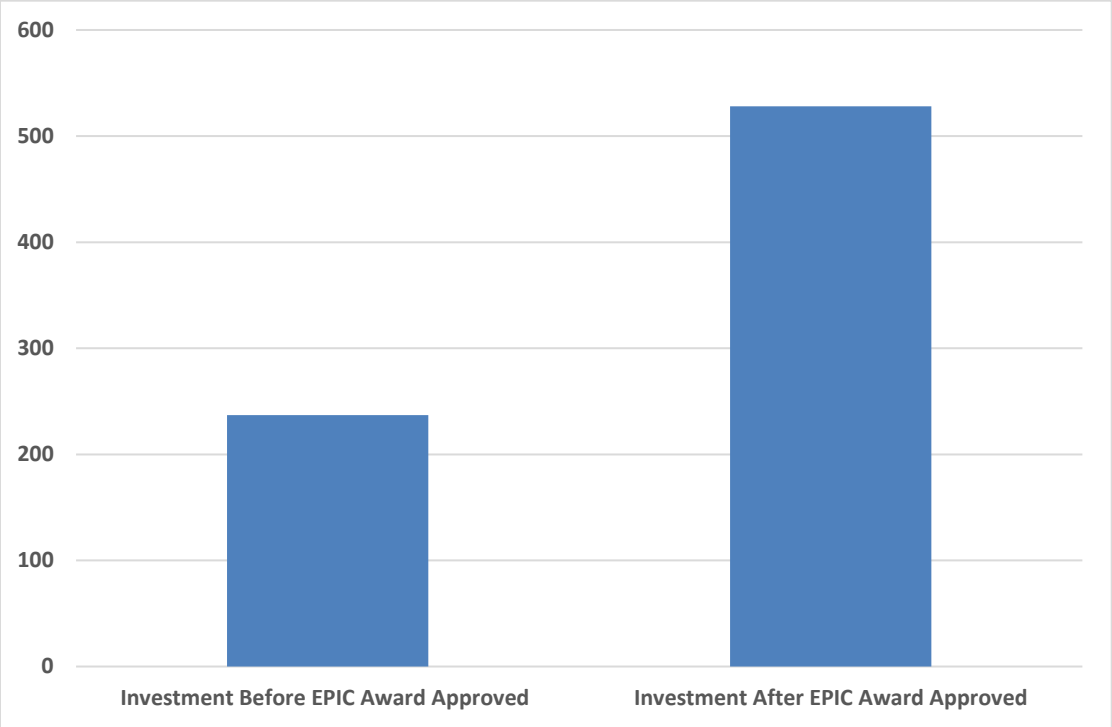
Bringing Broad Perspectives to Optimize Linkages Among Policies, Technologies, and Markets

Successfully commercializing new energy technology solutions depends on aligning policy, market, and technology drivers. The Energy Commission, as the state's primary energy policy and planning agency, plays a vital role in bringing stakeholder perspectives and expertise into EPIC planning and administration that reflect various policy, market, and technology drivers affecting the energy sector and the success criteria to be met by new energy technologies. Because these different perspectives are brought into the Energy Commission's solicitation scoping, selection, and project management, an Energy Commission award can provide a signal to private sector investors the potential of a new technology.

A staff analysis of data from Pitchbook indicates that private sector investors are responding to the Energy Commission's funding awards with additional investments in companies whose technologies are used in funded projects. Staff used Pitchbook to research 12 companies whose technologies were utilized in EPIC projects. The 12 companies represent sectors including energy storage, industrial chemicals, and software. These include firms that are either startups, revenue generating, or profitable. The Energy Commission compared the private sector investment in these companies before they were awarded an EPIC award and the private sector

investment they received after the award. Estimated investment in these companies before receiving approval for Energy Commission EPIC awards totaled $237 million, while estimated investment in the 12 companies totals $528 million after approval (Figure 1).

Figure 1: Private Investment Before and After EPIC Award (in Millions of Dollars) — Sample Group



Source: California Energy Commission staff analysis of data from Pitchbook.

The following provides further details on standard practices the Energy Commission takes to bring in broad stakeholder perspectives that help ensure the success of EPIC investments:

Scoping Workshops Help Unearth Policy and Market Pain Points That Demand New Technology Solutions

Energy Commission staff often holds workshops before the release of a solicitation for input from stakeholders to help adequately scope and focus a solicitation. Examples of input include determining whether the science around a particular technology area has advanced far enough to justify Energy Commission funding, or how a particular solicitation can leverage existing research results to avoid duplication. These workshops help Energy Commission staff target funding opportunities to areas of the greatest potential impact while providing stakeholders an opportunity to inform research funding priorities.

Technical Advisory Committees Provide Input That Can Help Improve the Success and Impact of a Project

Each project has a technical advisory committee (TAC) to provide guidance in project direction. TACs consist of diverse stakeholders who are not working on a project but provide their

experience and expertise to help guide project teams and provide independent feedback on the direction and results of the project. TACs may also be composed of potential users of the project results who can act quickly on the project results by, for example, adopting a specific technology or leveraging results for a future study. A project TAC is another vehicle that allows stakeholders to stay informed about the progress of EPIC-funded research.

Building Stakeholder Capacity Statewide to Develop and Adopt New Energy Technologies

One of the Energy Commission's core strategies through EPIC has been to build California's capacity to **develop, deploy and adopt** new energy technologies for investor-owned utility service territories. The following describes some of the specific actions the Energy Commission has taken to build up this capacity across the state.

Increase the business- and geographic diversity of clean energy entrepreneurship

The Energy Commission, through the *California Energy Innovation Ecosystem*, has built California's capacity to foster and support clean energy entrepreneurship. In designing and managing the programs that make up the *California Energy Innovation Ecosystem,* the Energy Commission has taken specific actions, where allowable, to increase the business and geographic diversity of clean energy entrepreneurship. These actions include:

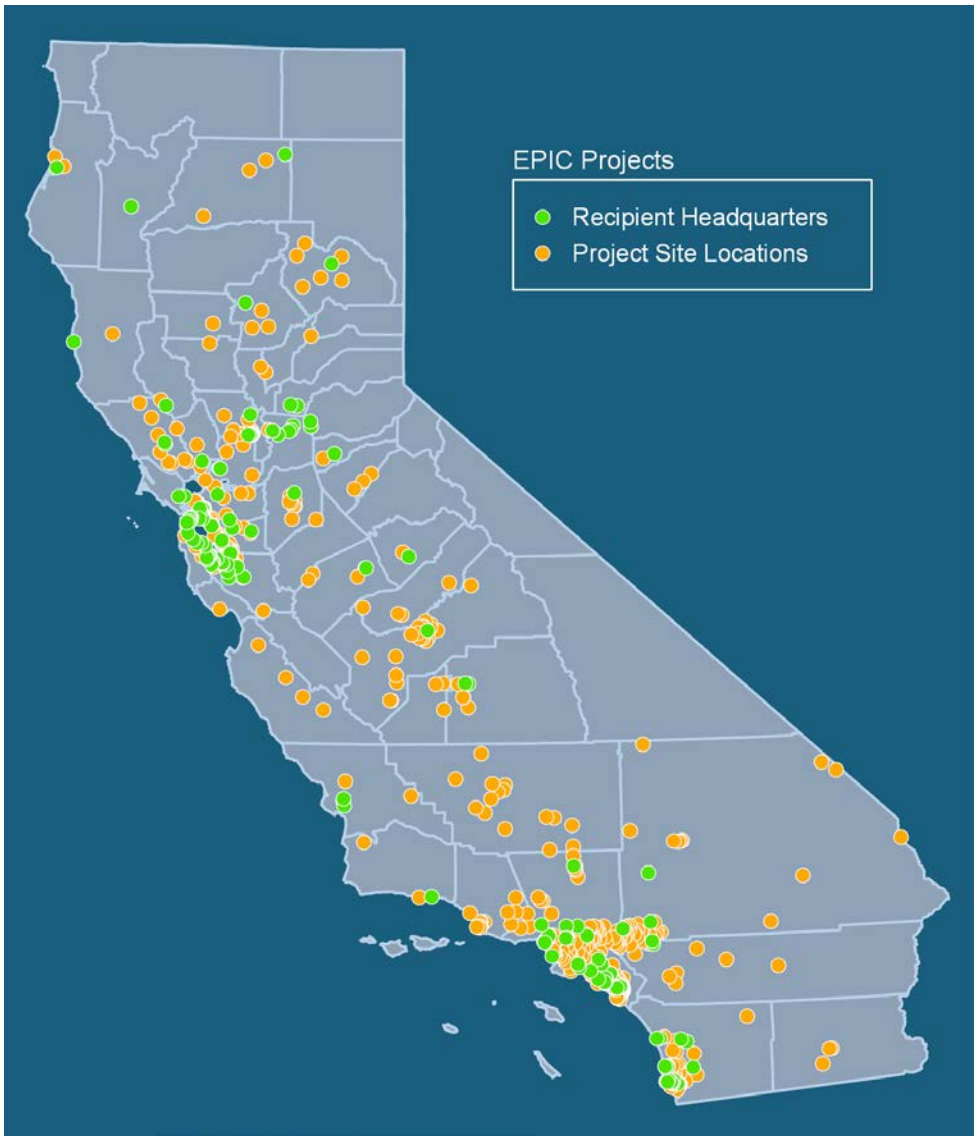
- Ensuring entrepreneurs in every California county have access to incubator services.
- Setting a minimum funding target in CalSEED for underrepresented groups such as minority-, women- and LGBT-owned businesses, and businesses in a disadvantaged community or rural part of the state.
- Requiring CalSEED applicants to apply based on their regional location to ensure and encourage geographic diversity.

In addition, the organizations managing the programs that make up the *California Energy Innovation Ecosystem* have successfully used their Energy Commission awards to secure federal funding that further supports entrepreneurs from underrepresented geographic locations and businesses.

Ensure the technological learning needed to streamline deployment of new energy technologies reaches a broad and diverse range of locations and customer segments

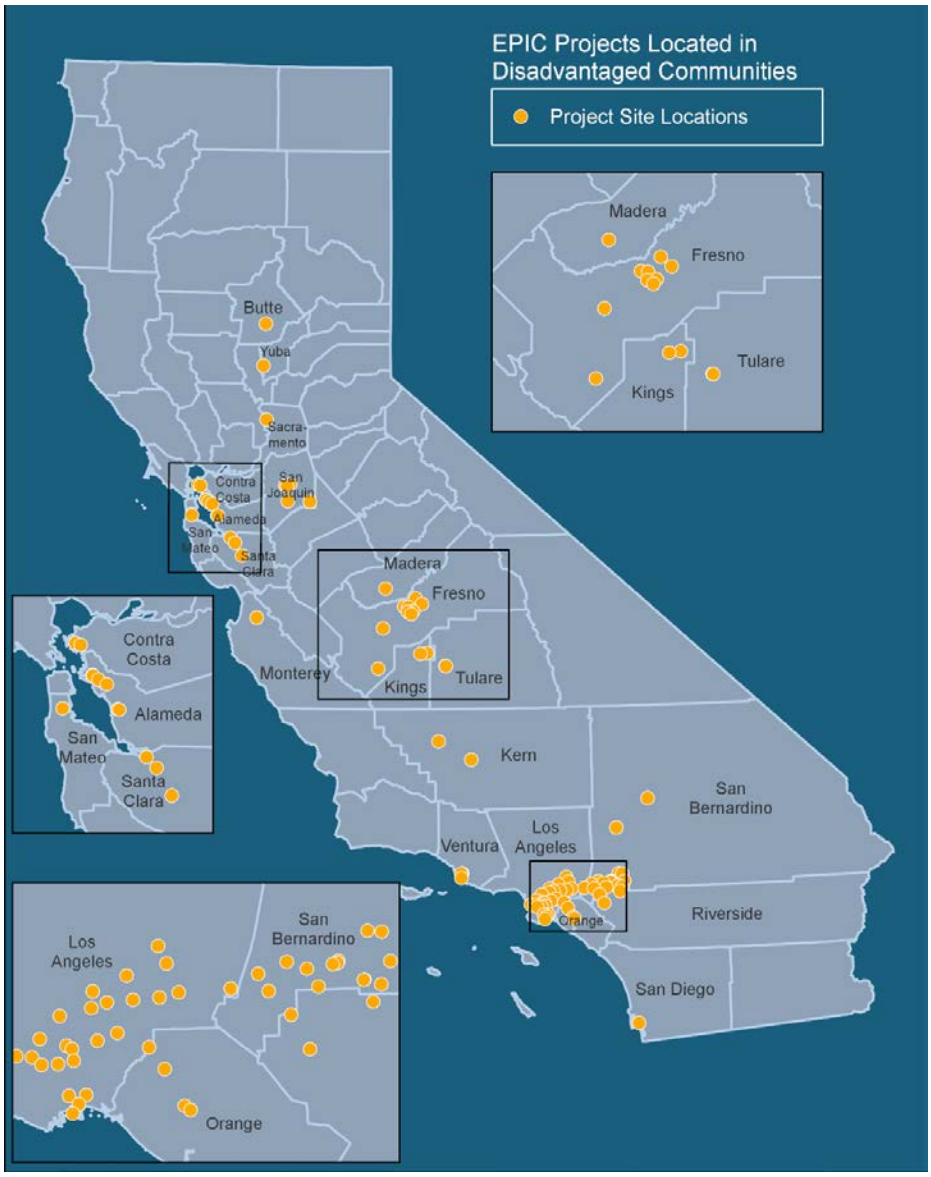
Technological learning is critical and necessary in launching new energy technologies. Technological learning happens primarily through the Technology Demonstration and Deployment program area when new technologies move out of the lab and into the real world. The Energy Commission, through targeted solicitation scopes, has taken steps to ensure the necessary technological learning reaches a range of geographic locations, market segments, and community types. The figures below illustrate the range of geographic locations of EPIC-funded projects since the EPIC program's first funding awards in 2014, through December 31, 2018. Figure 2 is a map of EPIC recipient headquarters and project site locations. Figure 3 is a map of all EPIC-funded projects in disadvantaged communities.

Figure 2: EPIC Recipient Headquarters and Project Site Locations



Source: California Energy Commission

Figure 3: EPIC Project Sites in Disadvantaged Communities



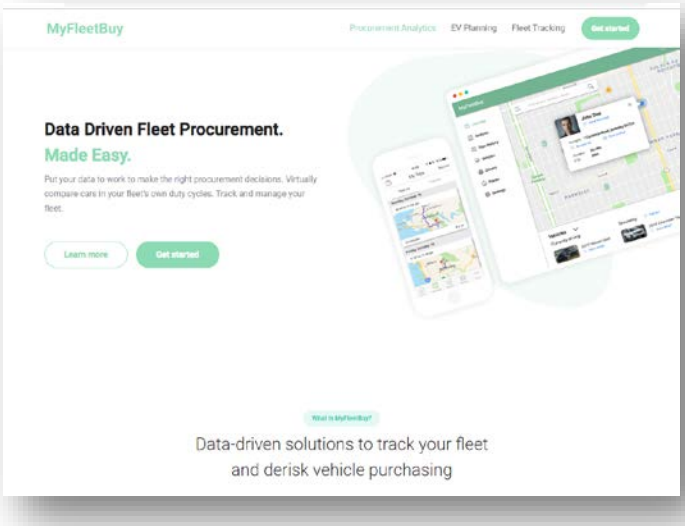
Source: California Energy Commission

Develop the Tools and Resources Required by Early-Adopter Customers and Mainstream Customers to Make Informed Decisions on New Energy Technology Adoption.

In 2014, the Energy Commission conducted a public workshop to understand barriers to end-use customer adoption of new energy technologies. Panelists and stakeholders cited numerous barriers, including vendor noise (potential customers overwhelmed by too many choices) and the time and cost to hire technical consultants to assist with expanding the market. To address these and other barriers, the Energy Commission kicked off several new EPIC projects in 2018 to develop new tools and resources to streamline customer adoption of emerging clean energy technologies. These projects include:

- **CalTestBed Initiative**—The CalTestBed Initiative is a voucher program that will provide clean energy companies access to testing centers to test or certify prototypes of pre-commercial DER technologies or both, and help them refine their prototype to meet customer specifications. This project will start with an initial network of testing centers that includes 29 University of California facilities from all 10 campuses and two National Laboratories and is expected to publicly launch in the fall of 2019.
- **MyFleetBuy**—Lawrence Berkeley National Lab is developing data-driven solutions to track vehicle fleets and de-risk vehicle purchasing. The MyFleetBuy platform allows a vehicle fleet manager to compare current fleet vehicles against electric vehicle alternatives, providing information on range forecasts, availability of charging stations, and the cost of charging versus fueling. MyFleetBuy provides the necessary information fleet managers to confidently transition their fleets to EV alternatives (Figure 4).
- **California Energy Product Evaluation Hub**—With few rigorous product evaluations to inform purchasing decisions, large commercial and institutional customers face enormous uncertainty and high costs associated with purchasing advanced energy efficiency, renewable distributed energy generation and energy storage products. Existing third-party resources do not typically provide information on specific products, nor do they allow for side-by-side comparisons of similar products or provide all of the information consumers need to make informed buying decisions. UC Davis is developing a product testing and rating system to evaluate end-use customer energy technology solutions in a rigorous and transparent manner and disseminate those results widely to large commercial and institutional customers that use a formal procurement process. This system will provide detailed, comprehensive, and generalizable information in a format that facilitates comparisons will provide buyers with valuable information to consider in procurement decisions.

Figure 4: Web Portal for the MyFleetBuy Application



Source: https://mygreencar.com/fleet/index.html

Facilitating Connections Between Technology Developers and Technology Adopters

The Energy Commission continues to host a networking hub on LinkedIn to help applicants connect, collaborate, and team up on proposals for Energy Commission solicitations. Each solicitation has discussion threads that allow users to share or request resources needed for a proposal. The LinkedIn Networking hub currently has more than 1,500 members.

In addition to the networking hub, the Energy Commission also hosts networking webinars following the release of a solicitation to allow prospective applicants to meet and form project teams. In 2018, the Energy Commission hosted four networking webinars with 68 participants.

The Energy Commission has started developing a new platform for stakeholders to more easily and efficiently connect and collaborate on clean energy projects. Expecting to launch in the first half of 2019, this new platform will allow users to create pages and identify the types of collaborations they are seeking. For example, a technology developer may want a site to host a demonstration, an investor may be looking for a company to support, or a researcher is searching for a community-based organization as a partner for a project located in a disadvantaged community. This new platform will facilitate these connections and provide disparate stakeholders a central location to find and connect with one another.

Leveraging Federal Funding

The Energy Commission and other stakeholders have long recognized that one of the key benefits of state-funded R&D programs is the ability to attract and leverage federal funding to California. Leveraging federal funding also provides efficient use of EPIC funding, one of the guiding principles of EPIC. The Energy Commission has developed a four-part strategy to use EPIC to leverage federal funds.

1. **Federal Cost Share solicitation.** The Federal Cost Share solicitation issued in 2018 replaces the one issued in 2014, and includes new streamlined procedures that will allow applicants to more easily apply for and receive EPIC funding for use as cost share.

   The purpose of these solicitations is to provide cost-share funding to applicants that apply for and receive an award under an eligible federal funding opportunity announcement. In 2018, the Energy Commission released a competitive solicitation that allows applicants to apply for EPIC as match funding in their application for a federal funding opportunity. Applicants interested in applying for EPIC funds for match submit a proposal to the Energy Commission's Federal Cost Share solicitation for an eligible Federal Funding Opportunity Announcement (FOA). Applicants with a passing score are provided a letter of cost share commitment to include in their federal proposal.
2. **Allow recipients to use current EPIC awards as cost share for federal funding opportunities on a case-by-case basis.** Periodically, a federal FOA is released when an EPIC project has already been awarded and is underway. In certain circumstances, the Energy Commission allows a recipient to use its EPIC award to meet the cost share requirements of the FOA if the project scopes are similar and other criteria are met.

3. **Competitively award follow-on funding for successful projects through a streamlined funding mechanism.** In 2017, the Energy Commission piloted a new funding mechanism called Bringing Rapid Innovation to Green Energy (BRIDGE) to award follow-on funding for the most promising technologies funded by the Energy Commission, U.S. Department of Energy (US DOE), and other federal agencies including the Defense Advanced Research Projects Agency and National Aeronautics and Space Administration. To be eligible, applicants must achieve the technical goals and targets of previous awards, have sizable interest and cost share from the private sector, and a go-to-market strategy for scaling up their technology in California. BRIDGE offers a streamlined path to move the most promising state and federally funded technologies from the lab into the marketplace. In 2018, the Energy Commission received the first set of proposals under BRIDGE and approved the first awards in January 2019.
4. **Providing technical assistance and training to help California energy technology companies be successful in federal procurement opportunities.** The federal government represents a crucial market for clean energy start-up companies. However, energy start-up companies are often unfamiliar with the complexities and nuances of federal procurement mechanisms. In 2018, the Energy Commission launched a new incubator program, the Energy Product Evaluation Hub, which is specifically focused on assisting and training energy start-up companies on applying to formal procurement opportunities offered through federal and state agencies, as well as other institutional organizations such as hospitals, schools and municipal facilities.

Energy Commission Ramps-Up Information Dissemination Activities

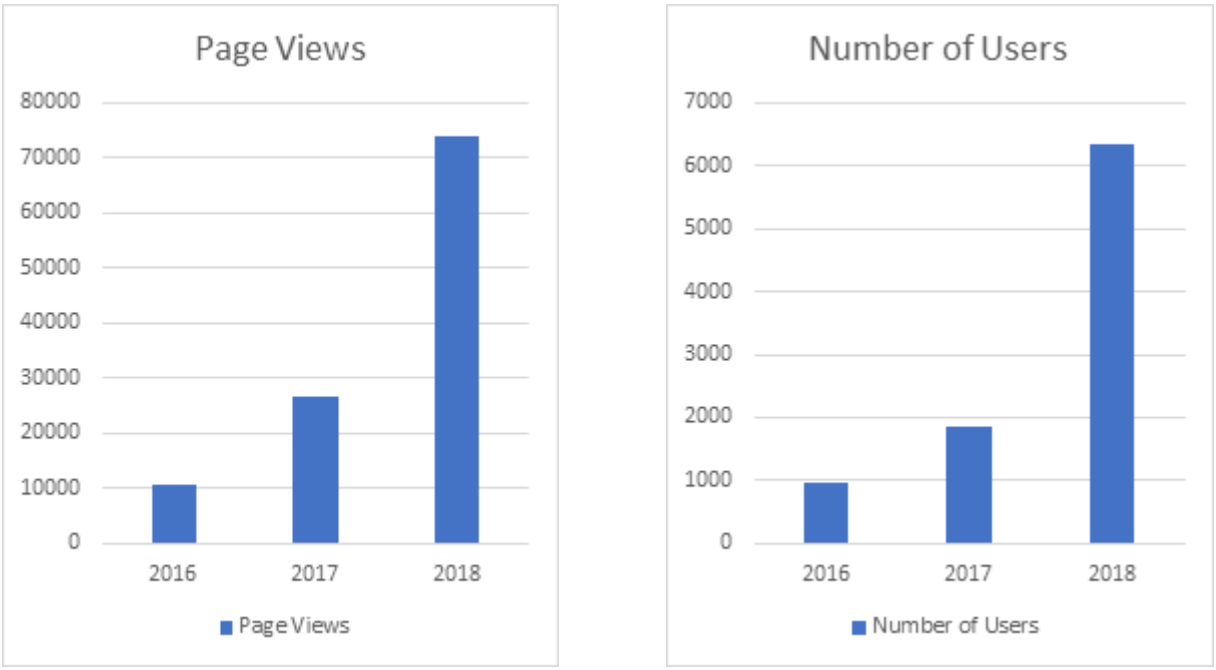
One of the key benefits of public research programs such as EPIC is the knowledge generated and made available to the public. Generating and distributing knowledge helps accelerate development and adoption of new scientific and technological advancements by ensuring future activities build on the successes and failures of previous efforts. In addition, the knowledge and project results can inform state and local policymakers of the technical and commercial readiness of new technology solutions for meeting near-term policy goals. Since the first EPIC projects began, the Energy Commission has been scaling up its activities and tools to ensure the knowledge generated from these projects reaches the broad range of stakeholders that are key to successful commercialization of new technologies capable of supporting California's multiple energy and climate change policy goals. Following are some of the key highlights of these activities:

Key Metrics for the Energy Innovation Showcase Grow Exponentially

In 2016, the Energy Commission launched an online project database called the Energy Innovation Showcase. The graphical web page gives insight on all EPIC-funded projects, lists the award recipients and funding amount, and explains how projects benefit ratepayers. The user can search projects by location, sector, and research topic. Since it went live in 2016, the annual number of page views and users has increased by more than 700 and 600 percent in 2017 and 2018 respectively (Figure 5). In 2019, the Energy Commission plans to overhaul the Energy

Innovation Showcase with a fresh redesign and increased functionality to improve its effectiveness and usefulness in disseminating knowledge and information from EPIC-funded projects.

Figure 5: Annual Number of Views and Users of the Energy Innovation Showcase



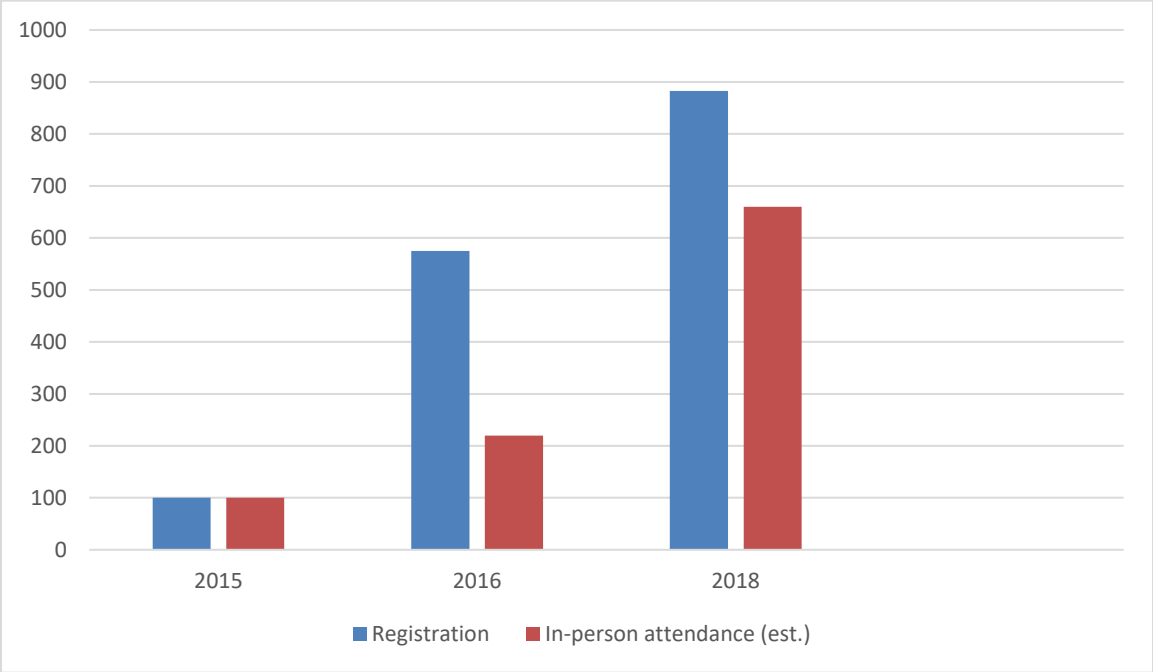
Source: Google Analytics

Attendance at the 2018 EPIC Annual Symposium Increases by More Than 600 Percent from the First Symposium

CPUC Decision 12-05-037 directs the EPIC administrators to hold a minimum of two events annually to engage with and consult stakeholders on the status of the EPIC program. The Energy Commission and the other EPIC administrators hold an annual EPIC Symposium as one of these events that showcases and shares project results from EPIC funded research. The EPIC Symposium is designed to help researchers, builders, government agencies, innovators and the public engage and learn more about cutting-edge energy strategies that are helping to evolve California's electricity system. The first EPIC Symposium was held on December 3, 2015 and drew approximately 100 attendees to the event. Since then, the Energy Commission has added new features including poster sessions, and an entrepreneur pitch fest. Since 2015, there has been a two-fold increase in in-person attendance for each EPIC Symposium, with more than 600 in-person attendees at the 2018 Symposium (Figure 6).

Since the Energy Commission did not use online registration for the 2015 symposium registration numbers are based on estimated in-person attendance.

Figure 6: Electric Program Investment Charge Symposium Trends



Source: California Energy Commission

The Energy Commission held the 2018 EPIC Symposium on February 7, 2018 at the Sacramento Convention Center (Figure 7). The 2018 Symposium featured a morning keynote from State Senator Nancy Skinner and an afternoon keynote from Assemblymember Autumn Burke. The all-day event featured panels focused on technology advancements to increase building efficiency, reduce the upfront cost of clean energy solutions for low-income families, and reduce the energy intensity and resulting greenhouse gas emissions in food processing facilities.

Figure 7: Well Attended Morning Keynote Address at the 2018 EPIC Symposium

Credit: California Energy Commission

EPIC Research Showcased in Webinar Series on the *(Fourth Assessment)*

In the last quarter of 2018 and first quarter of 2019, the California Energy Commission hosted a series of webinars highlighting results of energy-related research contributing to the *Fourth Assessment* funded by EPIC, Public Investment Energy Research – Natural Gas, and the Petroleum Violation Escrow Account. The results were particularly timely given such efforts as the CPUC's order instituting rulemaking (OIR) on adaptation (R.18-04- 019); former Governor Edmund G. Brown Jr.'s Executive Order B-55-18) to chart a resilient path to economy-wide, net zero emissions by 2045; and ongoing and planned state-supported efforts to advance the scientific understanding of how climate change will affect wildfire-related risks in California. Table 1 provides the subject and date for each webinar. For further information including technical reports and slides from these Fourth Assessment webinars, please go to the following website: http://www.climateassessment.ca.gov/events/.

Table 1: Webinars on *California's Fourth Assessment* Energy Sector Technical Reports

Webinar Title	Webinar Date
Engaging Energy Sector Stakeholders Through Multi-Scaled Vulnerability Analyses	November 15, 2018
Assessing the Impact of Wildfires on the California Electricity Grid	November 28, 2018
Modeling and Observations to Detect Neighborhood-Scale Heat Islands to Inform Effective Countermeasures in Los Angeles	December 5, 2018
Cal-Adapt: Linking Climate Science with Practitioner Need	December 6, 2018
Wildfire Simulations for the Fourth California Climate Assessment: Projecting Changes in Extreme Wildfire Events with a Warming Climate	December 10, 2018
Teleconnections and Cascading Impacts: Policy Implications and Lessons Learned in the Los Angeles Region	December 17, 2018
Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat	December 18, 2018
Climate, Drought, and Sea Level Rise Scenarios for the Fourth California Climate Assessment	January 16, 2019
Climate Adaptive Response Estimation: Short and Long Run Impacts of Climate Change on Residential Electricity and Natural Gas Consumption Using Big Data	January 18, 2019
Potential Impacts and Adaptation Options for Electricity and Natural Gas Systems from Climate Vulnerability in San Diego Area	January 24, 2019

Source: California Energy Commission

Increasing Diversity and Equity in EPIC

State policy supports EPIC's increased engagement and participation from underrepresented groups. Assembly Bill 865 (Alejo, Chapter 583, Statutes of 2015) directed the Energy Commission to take steps to increase the diversity of underrepresented businesses in EPIC. In addition, Senate Bill 350: Clean Energy and Pollution Reduction Act (De León, Chapter 547, Statutes of 2015) required the Energy Commission to conduct a study assessing barriers that prevent low-income customers, including those in disadvantaged communities, from participating in and benefiting from California's transition to a low-carbon economy. This resulted in *The Low-Income Barriers Study, Part A: Overcoming Barriers to Energy Efficiency and Renewables for Low-Income Customers and Small Business Contracting Opportunities in Disadvantaged Communities* (*SB 350 Barrier Study*), which recommends that 25 percent of the EPIC technology demonstration and deployment funding administered by the Energy Commission go towards projects located in and benefitting disadvantaged communities. Assembly Bill 523 (AB 523) (Reyes, Chapter 551, Statutes of 2017) codified that recommendation into law. In addition, AB 523 added new requirements for the Energy Commission's administration of the EPIC program:

- At least 25 percent of the EPIC technology demonstration and deployment funds go to projects located in and benefitting disadvantaged communities.
- At least ten percent of EPIC technology demonstration and deployment funds go to projects in and benefiting low-income communities.
- The Energy Commission consider the adverse localized health impacts of proposed projects to the greatest extent possible.

The Energy Commission has Developed a Three-pronged Strategy for Increasing Diversity and Equity in EPIC

The first part of this strategy is increasing awareness of EPIC funding opportunities through outreach. In 2018, the Energy Commission continued to scale up outreach. These efforts included adding the following new tools to the Energy Commission's outreach toolbox:

- Hosting online networking webinars for each EPIC funding opportunity as standard practice. These webinars provide opportunities for applicants to build teams and work together to develop effective project proposals.
- Revamping the Energy Commission's research landing page to make it easier and more intuitive for first-time users to find information.
- Creating and publishing a "How to Apply for Research Funding" video, which provides new applicants a quick four-minute overview of the first steps of applying for EPIC funding opportunities (Figure 8: "How to Apply for Research Funding" Video).

The second part of the Energy Commission's strategy is encouraging technology developers to seek projects that are in and benefiting disadvantaged communities and low-income communities. This strategy is accomplished primarily in the solicitation stage by either awarding preference points or having a funding set-aside for projects in and benefitting disadvantaged and low-income communities.

The third part of the Energy Commission's strategy is to scope solicitations around challenges or barriers affecting disadvantaged communities and low-income communities. For example, one solicitation this past year focused on technology and use innovations to overcome barriers to energy efficiency upgrades in low-income multifamily housing.

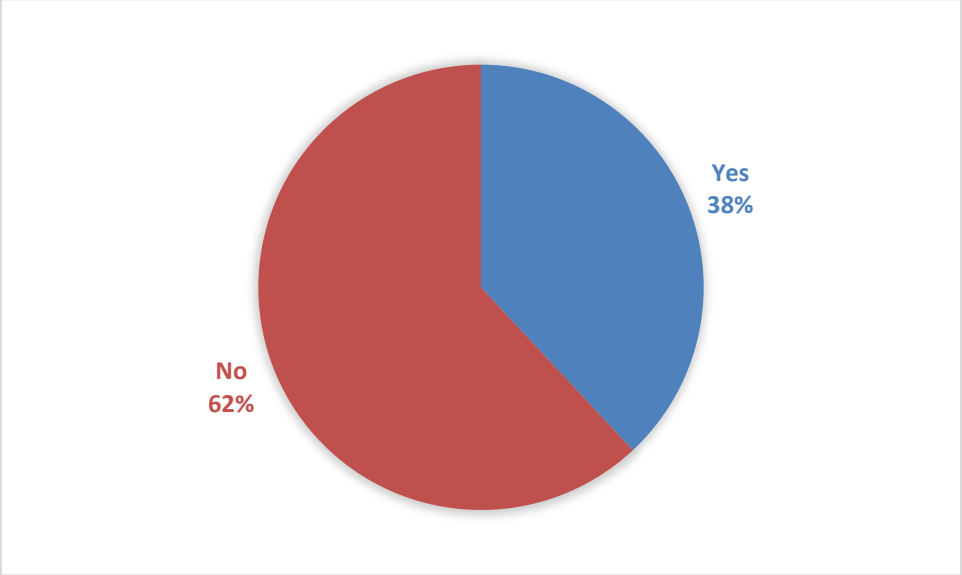
Figure 8: "How to Apply for Research Funding" Video

Source: California Energy Commission

Senate Bill 96 requires the Energy Commission to identify funding awards that include California-based entities, small businesses, or businesses owned by women, minorities, or disabled veterans. On April 8, 2015, the Energy Commission adopted the Diversity Policy Resolution outlining its commitment to ensure all Californians have an opportunity to participate in and benefit from Energy Commission programs that lead to job creation and training, improved air quality, and energy efficiency and environmental gains. The resolution recognizes that California's energy goals can best be met by tapping into the diversity of thought, talent, and perspective evident in its many communities. It also encourages disadvantaged and underrepresented businesses and communities including disabled veteran, women, LGBT, and minority-owned businesses to engage in and benefit from the Energy Commission's many programs.

Since 2014, Energy Commission staff has been using a voluntary survey for EPIC funding recipients to track participation of self-reported California-based entities, small businesses, and women, minority, LGBT, or disabled veteran owned businesses - whether these businesses participate as prime recipients or subcontractors in EPIC agreements. Furthermore, the surveys allow staff to identify opportunities for future outreach to encourage program diversity. Out of 307 agreements surveyed between 2014 and 2018, staff received responses from 247 (80%). Figure 9 shows an estimated percentage of EPIC agreements since 2014 that include a women, minority, disabled veteran, or LGBT owned business as a prime or subcontractor.

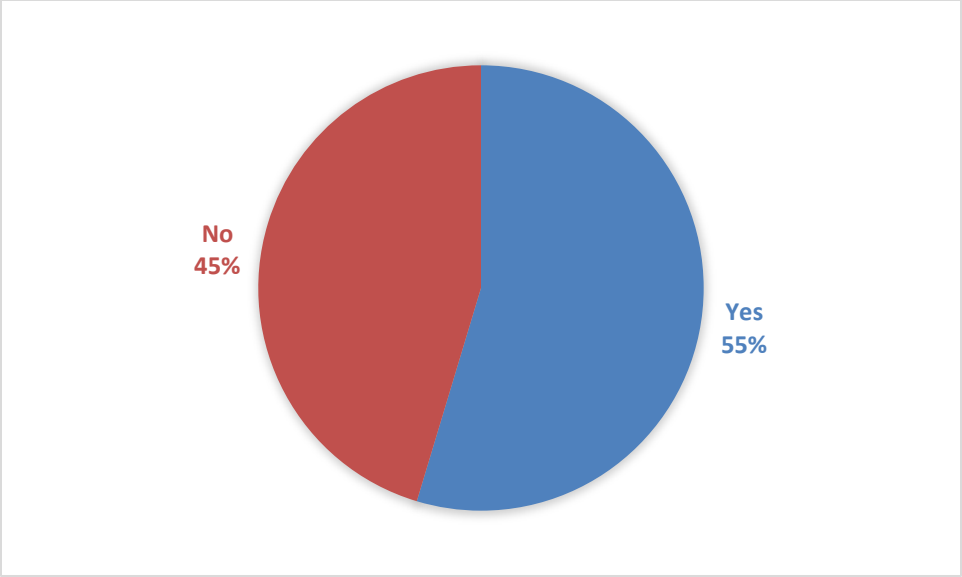
Figure 9: EPIC Agreements That Include Women, Minority, Disabled Veteran, or LGBT-Owned Business as a Prime or Subcontractor



Source: California Energy Commission

Figure 10 shows an estimated percentage of EPIC agreements that include a small business as a prime or subcontractor.

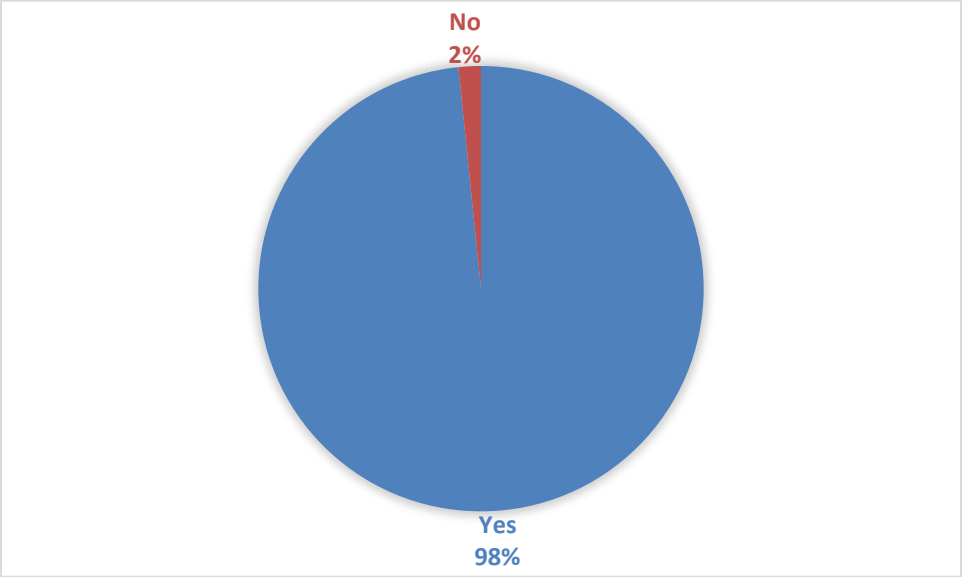
Figure 10: EPIC Agreements that Include a Small Business as a Prime or Subcontractor



Source: California Energy Commission

Figure 11 shows an estimated percentage of EPIC agreements that include a California-based entity as a prime or subcontractor.

Figure 11: EPIC Agreements that Include a California-Based Entity as a Prime or Subcontractor



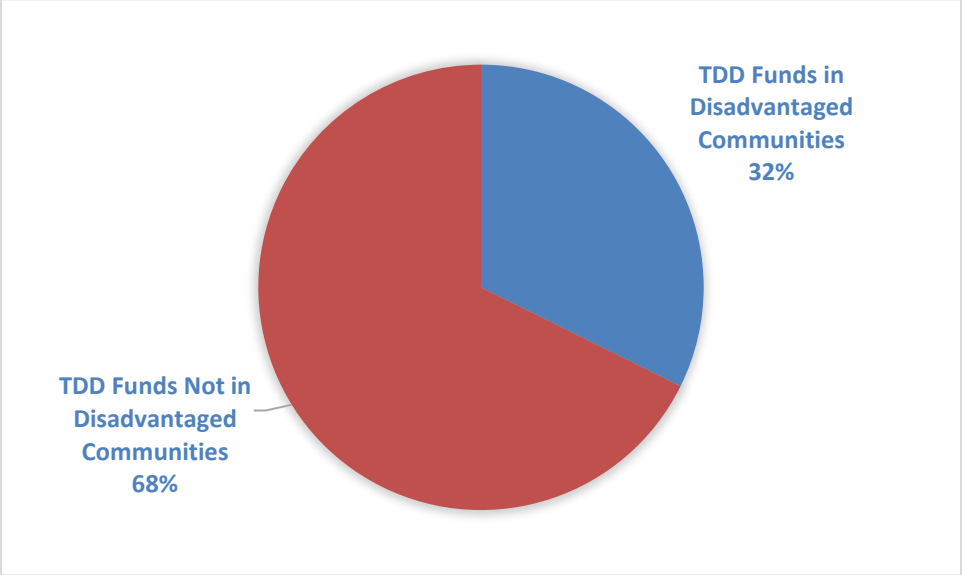
Source: California Energy Commission

Energy Commission began Assembly Bill 523 Implementation

AB 523 introduced new requirements to EPIC to ensure the program is benefitting disadvantaged- and low-income communities. In 2018, the Energy Commission began implementing the requirements of AB 523 and held two public workshops in May 2018 to solicit input.

The May 8 and 17 workshop materials, including draft scoring criteria were publicly posted and may be found here, https://www.energy.ca.gov/research/notices/#05172018. After the workshops, staff began revising EPIC grant funding opportunities and scoring criteria to incorporate considerations for project impacts and adverse localized health impacts, funding preferences for projects that benefit residents of low-income or disadvantaged communities, and allocations for projects that are located in and benefit low-income and disadvantaged communities. Furthermore, staff started efforts to engage communities throughout California, including more in-person discussions with community-based organizations and other community leaders. Staff plans to continue these efforts in 2019. In response to AB 523, the Energy Commission has prepared an estimate of the approximate percentage of funds spent on technology deployment and demonstration projects with project sites in disadvantaged communities. While AB 523 mandates a minimum of 25 percent of technology deployment and demonstration funds go to projects located in, and benefitting disadvantaged communities, since the inception of the EPIC program, approximately 32 percent of technology deployment and demonstration funds have been invested in projects located in a disadvantaged community. (Figure 12).

Figure 12: Estimated Percentage of EPIC Funds Spent on Technology Deployment and Demonstration Projects in Disadvantaged Communities



Source: California Energy Commission

Electric Program Investment Charge Components

CPUC Decision 12-05-037 approved the Energy Commission to administer EPIC funds in the following investment areas:

- **Applied Research and Development**: Activities supporting precommercial technologies and approaches designed to solve specific problems in the electricity sector, including research leading to advancements in clean energy technologies, demand-side technologies, and renewable energy. Activities that address environmental and public health impacts of electricity-related activities and support clean transportation with links to electricity sector ratepayer benefits also fall into this area.
- **Technology Demonstration and Deployment:** Installing and operating precommercial technologies or employing operational strategies at a scale large enough and in conditions reflective of anticipated operating environments to assess functional and performance characteristics and financial risks.
- **Market Facilitation**: Activities to support clean energy technology and strategy deployment. These activities include incubating statewide clean energy innovation and entrepreneurship efforts, reducing barriers to deployment of emerging clean energy solutions, developing the workforce needed to achieve the state's energy goals, encouraging greater participation from diverse businesses and communities, regulatory assistance and permitting, market research, program tracking, education and outreach, and strategy deployment. The CPUC Decision 12-05-037 clarifies that this category should not necessarily be limited to renewable energy and may include any other clean energy technologies or approaches or both.

Total EPIC funding for Energy Commission activities is summarized in Chapter 2. EPIC investments are mapped or correlated to the different elements of the electricity "value chain," which is composed of grid operations/market design, generation, transmission, distribution, and demand-side management. Based on the guiding principles, each EPIC investment plan maps strategic initiatives clearly to the appropriate section of the value chain. Each project funded through EPIC also maps clearly to the appropriate section of the value chain, consistent with an approved EPIC Investment Plan. (See Appendix B, Project Write-Ups)

Electric Program Investment Charge Regulatory Process

The CPUC oversees the Energy Commission's administration of EPIC funds, including approving the Energy Commission's EPIC investment plans. In addition, the Legislature must grant the Energy Commission spending authority to disburse EPIC funds for project awards and use EPIC funds for administrative expenses.

This EPIC annual report is provided to the CPUC in accordance with CPUC Decisions 12-05-037, 13-11-025, 15-04-020, and 18-10-052. To ensure consistent reporting for all administrators, these decisions specify the outline and contents of this report including individual project reporting requirements. The Energy Commission also provides this EPIC annual report to the Legislature, pursuant to California Public Resources Code Section 25711.5, and makes the report publicly available on its website.

Coordination

The Energy Commission is committed to ongoing coordination and collaboration with the three IOU administrators of EPIC funds and other energy innovation stakeholders in developing and implementing EPIC investment plans. This coordination is important to ensure funded EPIC projects address priority topics and critical funding gaps, as well as leverage other public and private funding sources.

Administrator Coordination

During 2018, Energy Commission staff collaborated with the three IOU EPIC administrators (PG&E, SCE, and SDG&E) by conducting biweekly conference calls, coordinating notification and outreach for upcoming events, and participating in public workshops. The following highlights EPIC administrator coordination for 2018.

- In 2018, the Energy Commission held meetings with the IOUs to discuss research updates and opportunities in vehicle grid integration, energy storage, and microgrids. These meetings led to follow-up discussions in the biweekly administrator telephone calls in which the Energy Commission staff provided updates on research located in each IOU territory, and shared fact sheets and discussed projects reports.
- On July 25, 2018, Energy Commission staff hosted a public workshop titled "Research Needs on Wildfire: Ensuring Grid Resilience and Public Safety." This workshop included coordination with the three IOUs, CPUC, UC Berkeley, California Department of Forestry and Fire Protection (CAL FIRE), Scripps Institute of Oceanography, and the Governor's

Office of Emergency Services (Cal OES). This workshop resulted in public feedback for a future Energy Commission solicitation on ignition prevention technologies (technologies that mitigate or prevent the electricity grid from igniting a wildfire). Out of this workshop came a recommendation for the Energy Commission to coordinate a working group with the three IOUs, CPUC, Cal Fire and Cal OES. The purpose of the working group is to seek input on potential research topics on ignition prevention and utility system vegetative intrusion detection and suppression to increase grid resilience and improve public safety. The first working group meeting was held on October 16, 2018 and a second meeting will be held in early 2019.

- On August 2, 2018, the Energy Commission and CPUC hosted a workshop on climate science, wildfires, and utility wildfire prevention. Energy Commission staff presented some of the emerging climate science results from research funded by EPIC. The workshop also included presentations from PG&E, SDG&E, SCE and other California utilities. The input from this workshop informed policy discussion and recommendations in the *2018 Integrated Energy Policy Report (IEPR).*

Coordination With Other Energy Innovation Efforts

In 2018, the Energy Commission engaged in several coordination efforts with other state and federal entities involved in similar RD&D activities, including:

- ***California's Fourth Climate Change Assessment***—The Energy Commission participated in the August 2018 release of the *Fourth Assessment.* The Energy Commission coordinated the execution and review of the studies with federal, state and local government agencies, and stakeholders. The Commission also assisted in the organization of regional events and webinars to share research results with practitioners. California's (*Fourth Assessment)* included six EPIC-funded energy research studies in a portfolio of more than 50 studies.
- **California State Agency Coordination—**
    - **California Air Resources Board (CARB)**: During 2018, CARB coordinated with the Energy Research and Development Division to review potential research areas related to energy related climate change, low-global-warming refrigerants, alternative transportation fuels, and indoor air quality.
    - **California Department of Water Resources (CDWR)**: CDWR discussed mutual research associated with desalination and nontraditional waters and potential gaps that need to be addressed with the Energy Research and Development Division.
    - **California Water Resources Control Board (State Water Board)**: With the Energy Research and Development Division, the State Water Board discussed mutual research associated with wastewater treatment and direct potable reuse of wastewater.

- **California League of Food Processors Exposition**—On February 21-22 staff attended the annual industry expo and presented information on food processing related projects.
- **Coordination with the Emerging Technologies Coordinating Council (ETCC)—**

  Members of the ETCC include the major electric and natural gas IOUs in California, as well as the Sacramento Municipal Utility District and Los Angeles Department of Water and Power, the Energy Commission, and the CPUC. The ETCC supports the advancement and adoption of emerging energy efficiency technologies. The Energy Commission participates in biweekly calls to promote communication and knowledge sharing on research projects and activities and opportunities for deployment of technologies and research results. In 2018, Energy Commission staff participated in advisory council meetings and two summits sponsored by the ETCC.

  - **April 27, 2018:** Emerging Technologies Coordinating Council Spring summit focused on industrial, agriculture and water (IAW) with panel discussions covering energy-related issues and integrated efficiency solutions to reduce energy and operating costs. Staff moderated a panel titled "Integrated Efficiency Solutions in the Industrial Space."
  - **October 9, 2018**: Emerging Technologies Coordinating Council, Fall Summit, focused on implementing advanced building practices, emerging technologies, and new building design and construction. Staff moderated a panel titled "Residential Codes and Standards: The Future of New Construction in California."
- **Energy Commission/CPUC Draft California Microgrid Roadmap**—In fall 2018, then Governor Edmund G. Brown. Jr. signed Senate Bill 1339 (SB 1339) (Stern, Chapter 566, Statutes of 2018) which requires the CPUC to develop new microgrid tariffs by December 2020. The Draft California Microgrid Roadmap, which is being developed by the Energy Commission in collaboration with the CPUC, and the California ISO, is being updated to include the tasks that support implementation of SB 1339.
- **United States. Department of Energy (U.S. DOE) Advance Research Projects Agency-Energy (ARPA-E) Energy Innovation Summit**—The ARPA-E Energy Innovation Summit was held near Washington, D.C. March 13–15, 2018. Energy Commission staff attended the event where experts from different technical disciplines and professional communities discussed energy challenges and innovations in terms of industry, research, and policy. Participants discussed program concepts and "out-of-the-box" opportunities. Insights from the summit informed ongoing work by the Energy Commission to coordinate with ARPA-E. Guided by an interagency MOU, the Energy Commission and ARPA-E work together to move transformational energy technologies out of the lab and into the market. Common areas of R&D include energy efficiency, energy storage, transportation, DERs, and power electronics.

- **U.S. DOE Coordination Meetings**—In March and May 2018, Energy Commission staff visited U.S. DOE staff in Washington D.C. to provide updates on R&D projects specific to energy storage and lesson learned from microgrid projects. Energy Commission and U.S. DOE staff also coordinated reviews of applicant proposals in response to Energy Commission and U.S. DOE R&D solicitations. Moreover, Energy Commission staff has an active working relationship with the U.S. DOE Energy Storage program at the U.S. DOE headquarters level and the functional staff level at Sandia National Laboratory. The Energy Commission coordinated energy storage research with the U.S. DOE energy storage experts to learn how the different technology providers are performing. In many cases, energy storage technology companies have grants with the Energy Commission and U.S. DOE. In 2018, the Energy Commission staff and the Sandia National Lab staff drafted a memorandum of understanding (MOU) for future coordination and sharing of information, which is expected to be finalized in 2019.
    - **Joint Conference Calls with U.S. DOE, Building Technologies Office**—In 2018, the Energy Commission initiated joint coordination meetings and calls with U.S. DOE's Building Technologies Office. The purpose is to share information on building-related research and identify opportunities for collaboration in such areas as HVAC, plug loads, demand response, building controls, and multifamily facades.
        - Plug Loads, January 10, 2018: Staff members discussed miscellaneous electric loads/plug loads, sensors, and controls and exchange information on projects, synergies, challenges, and potential areas for collaboration and identify opportunities for future discussion.
        - Building Controls, April 4, 2018: Purpose was to share information on building controls and demand response projects.
        - Direct Current (DC) Power Projects, November 28, 2018: Purpose was to share information on DC power projects and pursue possible collaborative opportunities.
        - Multifamily facades, November-December 2018: Purpose was to discuss the agenda and plans for the multifamily envelope workshop in California to complement a similar workshop that was held by the New York State Energy Research and Development Authority (NYSERDA).

- **Department of Defense Coordination Meetings**—In May 2018, Energy Commission staff visited Washington, D.C. to meet with Department of Defense (DoD) staff. During this visit, Energy Commission staff met with representatives from the Navy Resiliency Energy Program Office, the Army Office of Energy Initiatives and the Air Force Office of Energy Assurance.

  Energy Commission staff covered all current and planned R&D activities and provided information on how California military bases can participate in future EPIC grant

activities. Furthermore, in 2018, Energy Commission and U.S. Department of the Navy staff held two meetings in San Diego at Navy and Marine facilities to discuss a series of projects tracked and managed by Energy Commission and U.S. Department of the Navy staff. Then-Chair Robert B. Weisenmiller, Commissioner Janea Scott, Admiral Yancy B. Lindsey (Navy) and General Kevin Killea (Marines), participated in both meetings.

NYSERDA Coordination Meetings—During 2018, Energy Commission staff scored NYSERDA energy storage proposals and the NYSERDA staff reviewed EPIC microgrid proposals under GFO-17-302. The exchange provided valuable knowledge on the current state of energy storage and microgrid research nationally. These technical exchange opportunities allowed both agencies to share their energy storage and microgrid research results and plans. Moreover, in June 2018, Deputy Director Laurie ten Hope, of the Energy Commission R&D Division and Energy Commission staff visited NYSERDA to discuss current and future research plans for both organizations. During this meeting, the agencies discussed their grant award process, some of the successes and challenges they have experienced, and how the two agencies can work to share information more actively in the future.

Transparent Public Process and Solicitation Activities

The Energy Commission is committed to a transparent and public process in all phases of EPIC administration, including investment plan development and approval, competitive solicitation processes, and project approval and management.

In 2016 and 2017, Evergreen Economics, selected by the CPUC, conducted an independent evaluation of the EPIC program. In its analysis of the Energy Commission's solicitation process, Evergreen acknowledged the Energy Commission's contention that the technology innovation process often requires program administrators, grantees and others involved in the RD&D process to be able to modify quickly their scopes of work to maximize benefits. Evergreen recommended that the Energy Commission should explore how and whether it could add more flexibility to its grant request forms or research planning process, or both, to be able to respond to market and technology changes that occur between the time the project is proposed and the time the project is launched.

Regarding Evergreen's recommendation, the Energy Commission agrees that there may be circumstances where changes are needed to respond to market and technology changes between a project proposal and project start consistent with a competitive process for project selection. The Energy Commission selects projects using a competitive process. Projects are chosen based on the proposals submitted by applicants. Once an award is scored, the Energy Commission expects that the award recipient will carry out the project it proposed. The Energy Commission understands that research can be unpredictable and changes may need to be made to an agreement to promote success. However, significant changes that alter the intended purpose of the project potentially undermine the competitive process through which the project was originally selected.

To adapt to market and technology changes, the Energy Commission has used two new processes—BRIDGE and Phase II awards. These processes enable successful projects to receive follow-on funding while enabling projects to make adjustments that would not be feasible if the funding were awarded in a single process. The BRIDGE program is intended for successful projects that received state or federal funds or both to apply for additional funding between the time of completion of their original projects and when future state or federal funding opportunities are released. An example of a two-phase award was the funding opportunity for Advanced Energy Communities. Phase I focused on developing innovative planning, permitting, and financing approaches for advanced energy communities. The Energy Commission's solicitation defined Advanced Energy Communities as communities that:

- Minimize the need for new energy infrastructure costs such as transmission and distribution upgrades.
- Provide energy savings and local greenhouse gas emissions reductions.
- Support grid reliability and resiliency by incorporating technologies such as energy storage.
- Provide easier grid integration and alignment with the CPUC Long-Term Procurement Plan, and the California Independent System Operator's local capacity requirements process.
- Can be replicated and scaled-up to further drive down costs.
- Are financially attractive from a market standpoint (developers, home buyers, renters).
- Provide affordable access to renewable energy generation, energy efficiency upgrades, and water efficiency and reuse technologies that reduce electricity consumption for all electric ratepayers within the community.
- Make use of smart-grid technologies throughout the community.
- Align with other state energy and environmental policy goals at the community level such as the Sustainable Communities and Environmental Protection Act (Senate Bill 375, Steinberg, Chapter 728, Statutes of 2008) and Governor Brown's Executive Order B-29-15 for the drought.

Applicants selected for funding from Phase I were able to apply for Phase II of this solicitation, which supports the construction, commissioning, and evaluation of their advanced energy communities.

To help ensure a public process, the Energy Commission includes the following on its Web page (http://energy.ca.gov/research/epic/).

- EPIC program overview
- Previous and upcoming workshops

- Public comments
- Upcoming events
- How to sign up for the list serve
- Documents associated with the program, such as competitive solicitation materials and pre-application workshop recordings, notices of proposed awards, a fact sheet for each funded project, final project reports, EPIC annual reports, and triennial investment plans.

Also, the Energy Commission's website includes the Research Ideas Exchange, in which interested stakeholders can file their ideas for consideration in future solicitations. The Energy Commission created Docket Number 19-ERDD-01 to receive ideas from interested stakeholders.

In addition to providing information to the public on its website, the Energy Commission maintains the following social media webpages to educate and inform the public about activities and opportunities:

- Blog: http://calenergycommission.blogspot.com/
- LinkedIn: https://www.linkedin.com/company/california-energy-commission
    - LinkedIn Networking Hub: https://www.linkedin.com/groups/6925861/
- Facebook: https://www.facebook.com/CAEnergy/
- Twitter: https://twitter.com/CalEnergy

CHAPTER 2:
Budget

Authorized Budget

In 2018, the California Public Utilities Commission (CPUC) approved an EPIC budget for the third triennial investment cycle (2018-2020) in Decisions 18-01-008 and 18-10-052. Table 2 through Table 4 show the escalated funding for investment plans 2012-2014, 2015-2017, and 2018-2020, as approved by the CPUC.

Table 2: California Public Utilities Commission Approved Energy Commission Electric Program Investment Charge Funding for 2012-2014

Funding Element/Program Area	Total
Applied Research and Development	$158,700,000
Technology Demonstration and Deployment	$129,800,000
Market Facilitation	$43,300,000
Subtotal	$331,800,000
Program Administration	$36,900,000
Total	$368,700,000

Source: California Energy Commission

Table 3: California Public Utilities Commission Approved, Escalated Energy Commission Electric Program Investment Charge Funding for 2015-2017

Funding Element/Program Area	Total
Applied Research and Development	$158,166,500
Technology Demonstration and Deployment	$151,271,600
Market Facilitation	$55,566,400
Subtotal	$365,004,500
Program Administration	$40,782,600
Total	$405,787,100

Source: California Energy Commission

Table 4: California Public Utilities Commission Approved, Escalated Energy Commission Electric Program Investment Charge Funding for 2018-2020

Funding Element/Program Area	Total
Applied Research and Development	$158,912,222
Technology Demonstration and Deployment	$172,237,778
Market Facilitation	$66,230,000
Subtotal	**$397,380,000**
Program Administration	$44,400,000
Total	**$441,780,000**

Source: California Energy Commission

Funding Commitments and Encumbrances

To clarify the difference between commitments and encumbrances for the EPIC program, the CPUC adopted the following definitions in Decision 13-11-025:

> "'Committed funds' are funds identified during the planning of a solicitation for a specific project that will be needed to fund a contract or grant for that project at the conclusion of a planned or released solicitation … 'Encumbered funds' are funds that are specified within contracts and grants signed during a previous triennial investment plan cycle and associated with specific activities under the contract or grant. All activities carried out under a contract or grant during a specific triennial investment plan cycle need not be completed and funds need not be spent during that particular program cycle if the activities undertaken pursuant to the contract or grant are expected to be completed. Only funds that are committed or encumbered during the prior program cycle are eligible for being rolled into the following program cycle."[1]

Table 5 summarizes the approved investment plan, committed project funds and encumbered project funds for the three Investment Plans, as of December 31, 2018.

Table 5: California Public Utilities Commission Approved, Escalated Energy Commission Electric Program Investment Charge Project Funding

Investment Plan	Approved Plan Project Funds	Committed Project Funds (as of 12/31/18)	Encumbered Project Funds (as of 12/31/18)
2012-2014	$331,800,000	$331,800,000	$329,985,761
2015-2017	$365,004,500	$365,004,500	$319,969,161
2018-2020	$397,380,000	$40,369,303	$0

1 CPUC Decision 13-11-025, Ordering paragraphs 44 and 45.

Source: California Energy Commission

Approved Awards in 2018

In 2018, the Energy Commission approved 36 new projects totaling $128.5 million. A full list of submitted and awarded projects for each solicitation is available in the posted notice of proposed awards (NOPAs) on the Energy Commission's Funding Web page at https://www.energy.ca.gov/contracts/index.html#nopa.

Dollars Spent on Program Administration

The CPUC EPIC budget requirements cap administrative costs at 10 percent, excluding program evaluation costs. Expenditures for Energy Commission administrative costs totaled about $16.4 million in calendar year 2018.

The Energy Commission EPIC program administrative costs for calendar years 2012 through 2018 are nearly $72.9 million out of the $122.1 million from CPUC approved program administration budgets for the three EPIC Investment Plans. Therefore, the Energy Commission's administrative costs are within the approved budgeted amount.

Funding Shifts

EPIC administrators must obtain CPUC approval to shift more than 5 percent of funds between funding categories or program areas within an approved EPIC triennial investment plan.[2] In 2018, the Energy Commission did not shift funds between funding categories or program areas.

Uncommitted/Unencumbered Funds and Interest Accrual

As of December 31, 2018, there were no uncommitted funds from the first investment plan cycle. The Energy Commission has committed all second investment plan funds. About $37.7 million from the second investment plan remains unencumbered and needs to be approved at an Energy Commission business meeting and encumbered by June 30, 2019.[3]

In calendar year 2018, the Energy Commission accumulated approximately $7.9 million in interest from all funds in the EPIC account. The Energy Commission compensates for interest accruals by subtracting earned interest from its invoices to the IOUs.

2 CPUC Decision 13-11-025, Ordering Paragraph 36.

3 This does not include adjustments later made to project encumbrance amounts in 2018 due to projects that were terminated, cancelled, or reduced in project budgets.

CHAPTER 3: Projects

In 2018, the Energy Commission awarded EPIC funds to 36 new projects encumbering about $128.5 million. Since the beginning of the EPIC program, the Energy Commission has funded 303 project awards, encumbering about $650 million.

Summary of Project Awards

Table 6 lists the 303 projects that have been awarded funding since 2012 by strategic objective, number of projects funded, and total funding.

Table 6: Summary of EPIC Projects Awarded by Strategic Objective (2012-2018)

Strategic Objective	Number of Projects (as of December 31, 2018)	Total Funding*** (as of December 31, 2018)
2012-2014 EPIC Investment Plan		
Applied Research and Development		
S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector.	21	$38,815,729
S2: Develop New Technologies and Applications That Enable Cost-Beneficial Customer-Side-of-the-Meter Energy Choices.	10	$30,144,179
S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable.	12	$18,408,700
S4: Develop Emerging Utility-Scale Renewable Energy Generation Technologies and Strategies to Improve Power Plant Performance, Reduce Costs, and Expand the Resource Base.	8	$11,095,832
S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.	34	$18,252,181
S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020.	5	$5,401,868
S7: Develop Operational Tools, Models, and Simulations to Improve Grid Resource Planning.	2	$1,690,055
S8: Integrate Grid-Level Energy Storage Technologies and Determine Best Applications That Provide Locational Benefits.	5*	$8,673,198

Strategic Objective	Number of Projects (as of December 31, 2018)	Total Funding*** (as of December 31, 2018)
S9: Advance Technologies and Strategies That Optimize the Benefits of Plug-In Electric Vehicles to the Electricity System.	5	$6,681,669
S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies.	6**	$19,435,655
S11: Provide Cost Share for Federal Awards.	0	$0
Technology Demonstration and Deployment		
S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies.	20	$52,189,861
S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies.	13	$39,723,289
S14: Demonstrate the Reliable Integration of Energy-Efficient Demand-Side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy-Smart Community Development.	11**	$37,668,883
S15: Provide Cost Share for Federal Awards.	0	$0
Market Facilitation		
S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure.	11	$15,942,016
S17: Strengthen the Clean Energy Workforce by Creating Tools and Resources That Connect the Clean Energy Industry to the Labor Market.	2	$8,908,107
S18: Guide EPIC Investments Through Effective Market Assessment, Program Evaluation, and Stakeholder Outreach.	7**	$16,954,539
2012-2014 EPIC Plan Subtotal	**172**	**$329,985,761**

***This does not include five projects that were approved at an Energy Commission business meeting and later terminated by the recipient as of December 31, 2018. No work was done on these projects, and no EPIC funds were spent.**

****Six projects used funds from both the *2012-2014 and 2015-2017 EPIC Investment Plans*. These projects are indicated under the first plan (2012-2014) only. The amounts in the "Number of Projects" column and the "Total Funding" column include all projects, even those that are funded under both plans or more than one strategic objective.**

*****The amounts in the "Total Funding" column represent the project funding that was approved at an Energy Commission Business Meeting and any adjustments made thereafter – adjustments made thereafter are also included in Appendix C EPIC Project Status Report of this report.**

Strategic Objective	Number of Projects (as of December 31, 2018)	Total Funding*** (as of December 31, 2018)
2015-2017 EPIC Investment Plan		
Applied Research and Development		
S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.	31**	$53,639,904
S2: Enable Cost-Effective Demand Respond for California IOU Electricity Customers.	0	$0
S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.	19	$26,398,707
S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.	7	$7,105,218
S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.	13	$8,891,007
S6: Advance the Use of Smart Inverters as a Tool to Manage Areas With High Penetrations of PV.	1*	$2,935,822
S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.	5	$10,168,240
S8: Advance Customer Systems to Coordinate with Utility Communication Systems.	0	$0
S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.	4	$5,326,250
S10: Advance the Early Development of Breakthrough Energy Concepts.	0	$20,211,957
S11: Provide Federal Cost Share for Applied Research Awards.	7	$4,950,000
Technology Demonstration and Deployment		
S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.	9**	$46,222,821
S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.	6	$23,000,000
S14: Take Microgrids to the Next Level: Maximize the Value to Customers.	9	$44,978,120

Strategic Objective	Number of Projects (as of December 31, 2018)	Total Funding*** (as of December 31, 2018)
S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market, and Improve Grid Reliability.	2	$3,827,457
S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.	4*	$11,767,152
S17: Provide Federal Cost Share for Technology Demonstration and Deployment Awards.	2	$2,999,822
Market Facilitation		
S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.	2**	$23,091,074
S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.	4	$16,983,471
S20: Accelerate the Deployment of Energy Technologies in IOU Territories Through Innovative Local Planning and Permitting Approaches.	2	$2,487,609
S21: Inform Investments and Decision-Making Through Market and Technical Analysis.	4	$4,984,530
2015-2017 EPIC Plan Subtotal	**131**	**$319,969,161**
Grand Total	**303**	**$649,954,922**

Source: California Energy Commission

***This does not include four projects that were approved at an Energy Commission business meeting and later terminated by the recipient as of December 31, 2018. No work was done on these projects, and no EPIC funds were spent.**

**** Four projects used funds from 2015-2017 EPIC Investment Plan, but addressed more than one strategic objective within the plan. These projects are indicated under the first strategic objective only. The amounts in the "Number of Projects" column and the "Total Funding" column include all projects, even those that are funded under both plans or more than one strategic objective.**

***** The amounts in the "Total Funding" column represent the project funding that was approved at an Energy Commission Business Meeting and any adjustments made thereafter – adjustments made thereafter are also included in Appendix C EPIC Project Status Report of this report.**

Electric Program Investment Plan Project Status Report

Appendix C of this report includes a project status report for each project awarded EPIC funds and includes specific information in an electronic spreadsheet format using the template provided in Attachment 6 of CPUC Decision 13-11-025. Information included pursuant to Attachment 6 of CPUC Decision 13-11-025 for each project is as follows:

- Investment program period.
- Program administrator.
- Project name.
- Project type.
- Brief description of project.
- Date of award.
- Was this project awarded in the immediately prior calendar year?
- Assignment to value chain.
- Encumbered funding amount ($).
- Committed funding amount ($).
- Funds expended to date: contract/grant amount ($).
- Funds expended to date: in-house expenditures ($).
- Funds expended to date: total spent to date ($).
- Administrative and overhead costs to be incurred for each project.
- Leveraged funds.
- Partners.
- Match funding.
- Match funding split.
- Funding mechanism.
- Intellectual property.
- Identification of method used to grant awards.
- If competitively selected, provide the number of bidders passing the initial pass/fail screening for project.
- If competitively selected, provide the name of selected bidder.
- If competitively selected, provide the rank of the selected bidder in the selection process.
- If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected.
- If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.

- Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?
- How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals.
- Applicable metrics
- Project update

Description of Projects

Appendix B provides project write-ups for all active, approved, completed, and terminated (if EPIC funds were spent) projects in 2018, following the EPIC annual report outline from CPUC Decision 13-11-025, Attachment 5 (Item 4c of the outline).

Completed Projects

The 48 EPIC projects completed in 2018 are listed in Table 7. The final report for each of these projects, includes a comprehensive description of the project, detailed findings, and results, is or will be available at the Energy Commission website at the link provided.

Table 7: Completed Electric Program Investment Plan Funded Projects in 2018

Agreement #	Company	Project Name	Investment Program Period	Total Funds Encumbered	Final Report
300-15-008	Itron, Inc., dba IBS	Research Roadmap for Getting to Zero-Net-Energy Buildings	2012-2014 Triennial Investment Plan Applied Research and Development	$999,884	https://www.energy.ca.gov/2019publications/CEC-500-2019-031/index.html
300-15-010	Energetics Incorporated	Research Roadmap for Advancing Technologies in California's Industrial, Agricultural, and Water Sectors	2012-2014 Triennial Investment Plan Applied Research and Development	$647,728	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-016
300-15-013	ADM Associates, Inc.	California Investor-Owned Utility Electricity Load Shapes	2015-2017 Triennial Investment Plan Market Facilitation	$1,147,406	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-046
EPC-14-001	Itron, Inc., dba IBS	Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart	2012-2014 Triennial Investment Plan Applied Research and Development	$998,926	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-023

EPC-14-005	The Regents of the University of California, San Diego	Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid	2012-2014 Triennial Investment Plan Applied Research and Development	$999,984	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-028
EPC-14-010	Lawrence Berkeley National Laboratory	Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation	2012-2014 Triennial Investment Plan Applied Research and Development	$2,500,000	http://www.energy.ca.gov/2019publications/CEC-500-2019-040/index.html
EPC-14-012	Lawrence Berkeley National Laboratory	Comparing Attic Approaches for Zero-Net-Energy Homes	2012-2014 Triennial Investment Plan Applied Research and Development	$1,000,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-039
EPC-14-015	Lawrence Berkeley National Laboratory	Direct Current as an Integrating and Enabling Platform	2012-2014 Triennial Investment Plan Applied Research and Development	$1,000,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-038
EPC-14-016	BIRA Energy	Cost- and Energy-Efficient Attic Designs for California Homes	2012-2014 Triennial Investment Plan Applied Research and Development	$1,000,000	A final project report by the award recipient (available upon request) has been submitted to the Energy Commission and is currently in the Energy Commission publication process. Once approved and finalized the final project report will be posted on the Energy Commission website and accessible at the Research and Development Reports and Publications page: https://www.energy.ca.gov/research/reports_pubs.html.
EPC-14-024	West Biofuels, LLC	Modular Biomass Power Systems to Facilitate Forest Fuel Reduction Treatment	2012-2014 Triennial Investment Plan Applied Research and Development	$2,000,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-019

EPC-14-032	Inova Energy Group, LLC	Capturing Cultural Diversity in California Residential Energy Efficiency Potential: An Energy Ethnography of Hispanic Households	2012-2014 Triennial Investment Plan Market Facilitation	$224,593	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-029
EPC-14-037	Center for Sustainable Energy	Home Energy Efficiency Retrofits in California: An Analysis of Sociocultural Factors Influencing Customer Adoption	2012-2014 Triennial Investment Plan Technology Demonstration and Deployment	$599,924	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-018
EPC-14-054	Humboldt State University Sponsored Programs Foundation	Demonstrating a Renewable-Based Microgrid for a Critical Facility at the Blue Lake Rancheria	2012-2014 Triennial Investment Plan Technology Demonstration and Deployment	$5,000,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-011
EPC-14-056	Regents of the University of California, Los Angeles	Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid	2012-2014 Triennial Investment Plan Technology Demonstration and Deployment	$1,989,432	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-020
EPC-14-057	Lawrence Berkeley National Laboratory	Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets	2012-2014 Triennial Investment Plan Applied Research and Development	$1,993,355	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-036
EPC-14-060	San Diego Gas & Electric Company	Demonstrate a Utility-Owned Renewable-Based Community Microgrid at Borrego Springs California	2012-2014 Triennial Investment Plan Applied Research and Development	$4,724,802	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-013
EPC-14-064	Regents of the University of California, Riverside Campus	Aerosol Impacts on the Hydrology and Hydropower Generation in California	2012-2014 Triennial Investment Plan Applied Research and Development	$399,818	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-024

EPC-14-068	Maulbetsch Consulting	Evaluation of Cost, Performance and Water Conserving Capability of Hybrid Cooling	2012-2014 Triennial Investment Plan Applied Research and Development	$581,580	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-015
EPC-14-069	Energy and Environmental Economics, Inc. (E3)	Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System	2012-2014 Triennial Investment Plan Applied Research and Development	$700,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-012
EPC-14-073	Lawrence Berkeley National Laboratory	Monitoring the Urban Heat Island Effect and the Efficiency of Future Countermeasures	2012-2014 Triennial Investment Plan Applied Research and Development	$500,000	http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-007.pdf
EPC-14-074	The Regents of the University of California, Irvine	Building a Climate Change-Resilient Electricity System for Meeting California's Energy and Environmental Goals	2012-2014 Triennial Investment Plan Applied Research and Development	$698,792	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-015
EPC-14-078	ChargePoint Inc.	Next-Generation Grid Communication for Residential PEVs	2012-2014 Triennial Investment Plan Technology Demonstration and Deployment	$1,500,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-009
EPC-14-080	Charge Bliss, Inc.	Renewable Microgrid for a Medical Center	2012-2014 Triennial Investment Plan Applied Research and Development	$4,776,171	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-034
EPC-14-081	PowWow Energy, Inc.	Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption	2012-2014 Triennial Investment Plan Applied Research and Development	$2,292,829	https://www.energy.ca.gov/2019publications/CEC-500-2019-022/index.html
EPC-14-086	Electric Power Research Institute, Inc.	Distribution System Aware Vehicle to Grid Services for	2012-2014 Triennial Investment Plan	$1,499,977	https://www.energy.ca.gov/2019publications/CEC-500-2019-027/index.html

		Improved Grid Stability and Reliability	Applied Research and Development		
EPC-15-005	ICF Incorporated, L.L.C.	Potential Impacts and Adaptation Options for the Electricity System from Sea Level Rise in the San Diego Area.	2012-2014 Triennial Investment Plan Applied Research and Development	$499,929	http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-004.pdf
EPC-15-006	Lawrence Berkeley National Laboratory	Modeling the Impact of Wildfires on California's Transmission and Distribution Grid	2012-2014 Triennial Investment Plan Applied Research and Development	$500,000	http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-002.pdf
EPC-15-007	The Regents of the University of California, Los Angeles	Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat	2012-2014 Triennial Investment Plan Applied Research and Development	$500,000	http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-013.pdf
EPC-15-016	Amber Kinetics, Inc.	A Transformative Flywheel R&D Project	2012-2014 Triennial Investment Plan Applied Research and Development	$2,000,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-012
EPC-15-021	AGGIOS, Inc.	Mobile Efficiency for Plug-Load Devices	2012-2014 Triennial Investment Plan Applied Research and Development	$1,996,999	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-044
EPC-15-023	Lawrence Berkeley National Laboratory	Gaming System Energy Efficiency without Performance Compromises	2012-2014 Triennial Investment Plan Applied Research and Development	$1,386,530	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-042
EPC-15-029	Black & Veatch Corporation	Distributed Generation Environmental Planner	2012-2014 Triennial Investment Plan Applied Research and Development	$199,976	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-010

EPC-15-051	Lawrence Berkeley National Laboratory	The Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings	2012-2014 Triennial Investment Plan Market Facilitation	$500,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-041
EPC-15-055	Charge Bliss, Inc.	The Charge Bliss Advanced Renewable Energy Community for a Disadvantaged Southern California Community	2012-2014 Triennial Investment Plan Market Facilitation	$1,500,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-028
EPC-15-056	Natural Capitalism Solutions, dba Clean Coalition	Peninsula Advanced Energy Community (PAEC)	2012-2014 Triennial Investment Plan Market Facilitation	$1,318,997	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-025
EPC-15-058	The Regents of the University of California, Berkeley	The Oakland EcoBlock - A Zero-Net-Energy, Low-Water-Use Retrofit Neighborhood Demonstration Project	2012-2014 Triennial Investment Plan Market Facilitation	$1,500,000	http://www.energy.ca.gov/2019publications/CEC-500-2019-043/index.html
EPC-15-061	Regents of the University of California, Los Angeles	Using Data-Driven Approaches to Design Advanced Energy Communities for Existing Buildings	2012-2014 Triennial Investment Plan Market Facilitation	$1,497,996	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-010
EPC-15-065	Office of Energy and Sustainable Development, City of Berkeley	Berkeley Energy Assurance Transformation (BEAT) Project	2012-2014 Triennial Investment Plan Market Facilitation	$1,499,214	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-014
EPC-15-066	Groundwork San Diego-Chollas Creek	Developing an Advanced Energy Master Plan for the Encanto Neighborhood in San Diego	2012-2014 Triennial Investment Plan Applied Research and Development	$1,500,000	http://www.energy.ca.gov/2018publications/CEC-500-2018-034/
EPC-15-067	Local Government Commission	Integrated Community Resource Marketplace	2012-2014 Triennial Investment Plan Market Facilitation	$1,500,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-027

EPC-15-068	Lawrence Berkeley National Laboratory	Understanding and Mitigating Barriers to Wind Energy Expansion in California	2012-2014 Triennial Investment Plan Market Facilitation	$200,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-035
EPC-15-069	Zero Net Energy (ZNE) Alliance	Lancaster Advanced Energy Community (AEC) Project	2012-2014 Triennial Investment Plan Market Facilitation	$1,469,779	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-032
EPC-15-071	Biodico, Inc.	Zero Net Energy Farms	2012-2014 Triennial Investment Plan Market Facilitation	$1,175,919	http://www.energy.ca.gov/2019publications/CEC-500-2019-045/index.html
EPC-15-076	Zero Net Energy (ZNE) Alliance	Richmond Advanced Energy Community Project	2012-2014 Triennial Investment Plan Applied Research and Development	$1,480,111	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2018-031
EPC-15-077	The Regents of the University of California, Irvine Advanced Power and Energy Program	Huntington Beach Advanced Energy Community Blueprint	2012-2014 Triennial Investment Plan Market Facilitation	$1,500,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-047
EPC-15-080	Thalassa Research & Consulting, LLC	Interdependencies of Electric Grid and Critical Lifelines: Identifying Climate Exposure and Adaptation Strategies	2012-2014 Triennial Investment Plan Applied Research and Development	$128,188	http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-008.pdf
EPC-15-093	Water Energy Innovations, Inc.	Accelerating Drought Resilience Through Innovative Technologies	2015-2017 Triennial Investment Plan Market Facilitation	$1,000,000	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-037
EPC-16-008	City of Santa Monica	Santa Monica Advanced Energy District	2015-2017 Triennial Investment Plan Market Facilitation	$1,487,609	https://www.energy.ca.gov/publications/displayOneReport.php?pubNum=CEC-500-2019-032

Source: California Energy Commission

CHAPTER 4: Conclusion

Key Results for 2018 for the Energy Commission's EPIC Program

- In 2018, the Energy Commission released four competitive solicitations. The solicitations were in the following areas: assessing and preparing for wildfire risks under climate change, accelerating the deployment of advanced energy communities, technology transfer for research projects, and updated cost share for federal funding opportunities. The Federal Cost Share solicitation issued in 2018 replaces the one issued in 2014, and includes new streamlined procedures that will allow applicants to more easily apply for and receive EPIC funding for use as cost share.
- As of December 31, 2018, the Energy Commission had encumbered $128.5 million for 36 new projects approved in 2018.
- As of December 31, 2018, the Energy Commission has invested approximately 32% of its TD&D program funds in projects that have a project site in a Disadvantaged Community.
- Forty-eight EPIC projects were completed in 2018. The final report for each of these projects, including a comprehensive description, detailing findings and results, is or will soon be available at the Energy Commission website.[4]
- On January 11, 2018, the California Public Utilities Commission (CPUC) modified and approved the Energy Commission's EPIC 2018-2020 Investment Plan.
- As required, the Energy Commission filed its 2017 EPIC annual report with the CPUC in February 2018 and, in April 2018 transmitted its 2017 EPIC Annual Report to the Legislature.
- More than 600 people attended the 2018 EPIC Symposium on February 7, 2018 at the Sacramento Convention Center and several hundred attended online.
- In 2018, the Energy Commission continued to scale up its program outreach. This included creating and publishing a "How to Apply for Research Funding" video, which provides a quick four-minute overview of early steps new applicants should take when starting to apply for EPIC funding opportunities.
- The Energy Commission held two public workshops in May 2018 to solicit input on implementing the requirements of AB 523.
- Staff presented on research efforts to support building decarbonization. on June 14, 2018, at the *Integrated Energy Program Report* (*IEPR)* workshop on "Achieving Zero-

4 https://www.energy.ca.gov/2018publications/.

Emission Buildings" to discuss the potential for reducing the greenhouse gas emissions in buildings and achieving zero-emission buildings in California (Docket 18-IEPR-09).

- On July 25, 2018, Energy Commission staff hosted a public workshop titled, "Research Needs on Wildfire: Ensuring Grid Resilience and Public Safety."
- On August 2, 2018, the Energy Commission and CPUC hosted a workshop on climate science, wildfires, and utility wildfire prevention. Energy Commission staff presented some of the emerging climate science results from research funded by EPIC.
- In August 2018, the *Fourth Assessment* was completed. The Energy Commission contributed six EPIC-funded research projections to *California's Fourth Climate Change Assessment*.
- On August 30, 2018, the California Energy Commission held an *IEPR* workshop titled, "Lead Commissioner Research Workshop on Climate-Related Risks to California's Energy System: Insights from California's Fourth Climate Change Assessment 2018."
- On August 21, 2018, staff held a workshop titled, "Scoping Workshop on Developing Lessons Learned, Best Practices, Training Materials and Guidebooks for Customer Side of the Meter Energy Storage." This workshop was held as part of the Governor's Office of Planning and Research's implementation of Assembly Bill 546 (Chiu, Chapter 380, Statutes of 2017) and the development of guidebooks for energy storage implementation on the customer side of the utility meter.
- On September 7, 2018, staff held a stakeholder workshop titled "Research Needs for Thin-film Photovoltaic Technologies" to identify research needs and opportunities for thin-film solar photovoltaic systems and new high-value applications.
- On October 16, 2018, staff held a stakeholder workshop titled "Research Needs on Ignition Prevention and Utility Vegetative Intrusion Detection and Suppression", to seek stakeholder feedback on priority research needs.
- On October 25, 2018, staff held a stakeholder the workshop "Next Generation Wind Energy Technologies and their Environmental Implications" to discuss research needs and opportunities for developing and launching next-generation wind energy technology in California.
- On November 15, 2018, Commissioner David Hochschild and California Energy Commission staff held a workshop seeking input from stakeholders regarding lithium recovery from geothermal brine. Topics included demand for development, barriers and opportunities, and policy and funding priorities.
- In 2018, the Energy Commission kicked-off several new projects that will develop new tools and resources for those interested in adopting new clean energy technologies to evaluate and assess clean energy solutions that are right for them. These projects include the CalTestBed Initiative, MyFleetBuy, and the California Energy Product Evaluation Hub.
- In 2018, the Energy Commission awarded EPIC funding to establish programs and resources to help distributed energy resources (DER) sellers identify current buyer

wants, awareness, needs, and requirements while aligning the interests and aggregating the market power of major institutional buyers to lower costs and accelerate deployment of best-in-class DERs.

- In 2018, the Energy Commission hosted four networking webinars.
- The following EPIC funded projects were highlighted at the American Council for Energy Efficient Economy (ACEEE) – 2018 Summer Study conference:
    - EPC-16-002: Pathways to More Cost-Effective ZNE Homes, Max Wei, LBNL
    - EPC-15-024: Efficient and ZNE-Ready Plug Loads, Alan Meier, LBNL
    - EPC-15-051: Value Proposition for Cost-Effective, DR-Enabling Non-Residential Lighting System Retrofits in CA Buildings, Peter Schwartz, LBNL
    - EPC-15-022: Power Management User Interface, Joy Pixley, UCI
    - EPC-14-012: Comparing Attic Approaches for ZNE Homes, Iain Walker, LBNL
    - EPC-14-021, Development and Testing of Next-Generation Residential Space Conditioning, Ammi Amarnath, EPRI
    - EPC-15-026: Unlocking Plug-Load Energy Savings Through Energy Reporting, Bruce Nordman, LBNL

Next Steps for the Electric Program Investment Charge Investment Plan

The Energy Commission's next steps for EPIC administration include the following:

- The Energy Commission will continue implementation of the *Electric Program Investment Charge 2018 – 2020 Triennial Investment Plan*.
- Through the implementation of AB 523, the Energy Commission will continue efforts to ensure that participation in the EPIC program reflects the rich and diverse characteristics of California and its people, including its low-income and disadvantaged communities.
- Looking ahead, the Energy Commission has started development of a new platform that will allow stakeholders to more easily and efficiently connect and collaborate on clean energy projects. Expecting to launch in the first half of 2019, this new platform will allow users to create pages and identify what types of collaborations they seek.
- The Energy Commission plans to overhaul the Energy Innovation Showcase project database with a fresh redesign and increased functionality to improve the effectiveness and usefulness of the database in disseminating knowledge and information from EPIC-funded projects.
- The Energy Commission will continue to take steps to respond to the EPIC Evaluation Final Report recommendations.

Issues

The EPIC annual report is required to include a discussion of issues "that may have major impact on progress in projects, if any."[5]

Table 8 lists the six EPIC projects which had issues impacting project progress and were terminated in 2018. For projects terminated in 2018 with expended EPIC funds, an additional project write-up is included in Appendix B.

Table 8: EPIC Funded Projects Terminated in 2018

Agreement #/ Prime Applicant	Project Title	Project Description	EPIC Investment Plan/ Investment Area	Reason for Termination
EPC-14-041 Biogas & Electric, LLC	Installation of a Lean Burn Biogas Engine with Emissions Control to Comply with South Coast Air Quality Management District's Rule 1110.2 for Wastewater Treatment Plants	This project aimed to design, build and install a continuously operating commercial scale emissions reduction system for the lean burn biogas engine(s) at a municipal wastewater treatment plant in Palm Springs California. If successful, the project would have enable lean burn biogas engines to comply with existing and future air quality regulations when deployed at wastewater treatment plants, resulting in reduced flaring and net reductions in emissions.	*2012-2014 Investment Plan* Technology Demonstration and Deployment	Biogas and Electric, LLC lost its demonstration site resulting in many delays. A new site was found but the redesign, equipment acquisition and installation would have taken a significant amount of time. An amendment to extend the term was initiated by Biogas and Electric, LLC, although it did not sign the extension and backed out of the project. As a result, a majority of the deliverables and the Final Report were not completed.
EPC-14-077 Center for Sustainable Energy	Vehicle-Grid Integration in California Using the ISO/IEC 15118 Global Interoperability Standard	The project was intended to design and develop a Demand Clearing House (DCH) to monitor published energy pricing from the California Independent System Operator's Fifteen-Minute Energy Market as well as load forecasts from San Diego Gas & Electric and other participating utilities through an Application Programming Interface translation from Open ADR 2.0b, a Demand Response protocol used by all California Investor Owned Utilities. The DCH would have then used algorithms that convert grid conditions into ISO/IEC 15118 "grid profiles," or Tariff Tables, which in turn would be communicated to 15118-capable charging stations and	*2012-14 Investment Plan* Applied Research and Development	Center for Sustainable Energy (CSE) experienced project delays due to the loss of a major subcontractor that resulted in the loss of their demonstration site. CSE was not able to find a new demonstration site that fit all of the project criteria and decided they could not satisfactorily complete the project before the funds were

[5] CPUC Decision 13-11-025, Attachment 5.

		vehicles. A fully developed DCH would allow utilities to respond to supplemental energy market prices, proving a viable and scalable pathway toward using plug-in electric vehicles to manage variable grid conditions, solar oversupply, and other system wide challenges.		scheduled to expire. As a result, a majority of the deliverables and the Final Report were not completed.
EPC-15-052 ZipPower, LLC	ZipPower San Leandro	This project was to develop and pilot a platform that optimizes distributed energy resource planning by integrating and automating all the data required to target optimal sites across city areas, and streamline pre-approval of the permitting and interconnection at those sites. The project planned to use aggregated customer financing as an option to design, finance, deploy, scale, and replicate Advanced Energy Communities.	*2012-2014 Investment Plan* Market Facilitation	Throughout the term of the agreement, ZipPower, LLC requested significant budget changes, and numerous project team changes, resulting in insufficient progress and excessive delays, as well as low confidence from the Energy Commission in ZipPower, LLC's ability to build and maintain a successful project team.
EPC-15-064 Prospect Silicon Valley	Innovative Net Zero: ZNE Demonstration in Existing Low-Income Mixed-Use Housing	This project was to demonstrate the installation of innovative technologies to retrofit an existing, low-income, mixed-use multi-unit building in a dense urban setting to become zero-net energy.	*2012-2014 Investment Plan* Technology Demonstration and Deployment	The project encountered a significant construction obstacle that affected the budget but was unable to identify alternative cost effective retrofits that met the requirements of the grant. It could no longer meet solicitation goals and be completed within the agreement term.
EPC-16-060 Motiv Power Systems, Inc.	Adaptive Chargers for Delivery Customers Demonstrating California Advances in Charging	This project was to develop a smart charger solution and a bi-directional charger solution to enable vehicle-grid integration (VGI) with electric fleet vehicles.	*2015-2017 Investment Plan* Technology Demonstration and Deployment	Internal business conditions prevented Motiv Power Systems, Inc. from fulfilling obligations under the agreement.
EPC-16-069 Advanced Microgrid Solutions, Inc.	Demonstrate the Phase III Functions of a PV Smart Inverter and a Storage Inverter	This project was to test and validate the Phase III functions of a PV smart inverter and a storage inverter to support higher penetrations of solar on the feeder to the South Coast AQMD Headquarters in Diamond Bar, California integration costs.	*2015-2017 Investment Plan* Applied Research and Development	Loss of the site where the work was to be performed, prevented Microgrid Solutions, Inc. from fulfilling the obligations under the agreement.

Source: California Energy Commission

GLOSSARY

Term	Definition
AB	Assembly Bill
AR&D	Applied research and development
ARPA-e	Advanced Research Projects Agency-Energy – a United States Department of Energy Program advancing high-impact energy technologies by providing funding, technical assistance, and market readiness
California ISO	California Independent System Operator
CO_2	Carbon dioxide
CPUC	California Public Utilities Commission
Disadvantaged Community	A community that scores at or above 75% in the version of CalEnviroScreen that was available at the time of project application.
EPIC	Electric Program Investment Charge
EPRI	Electric Power Research Institute
FOA	Funding opportunity announcement
Frequency Regulation	The addition or subtraction of electrical energy into the grid to keep the frequency as close to 60 Hertz as possible
HVAC	Heating, ventilation, and air conditioning
IEPR	Integrated Energy Policy Report
IOU	Investor-owned utility
Load Following	A technique to match and adjust the power available to the electrical load as the load demand for electricity fluctuates
NOPA	Notice of proposed awards
Peak Shaving	A technique that is used to reduce electrical power consumption during periods of maximum demand on the power utility
PG&E	Pacific Gas and Electric Company
RD&D	Research, development, demonstration, and deployment
SB	Senate Bill
SCE	Southern California Edison Company

Term	Definition
SDG&E	San Diego Gas & Electric Company
Smart grid	A smart grid is the thoughtful integration of intelligent technologies and innovative services that produce a more efficient, sustainable, economic, and secure electrical supply for California communities.
Smart inverter	An inverter with communications capability to send and receive messages that can ensure proper operation of the electric grid
TD&D	Technology deployment and demonstration
U.S. DOE	United States Department of Energy
WECC	Western Electricity Coordinating Council
ZNE	Zero-net energy

APPENDIX A:
Energy Commission Electric Program Investment Charge Reporting Requirements for 2018

The Energy Commission is committed to full compliance with all EPIC reporting and informational requirements. The following table (A-1) lists all Energy Commission EPIC reporting and informational requirements for calendar year 2018. These requirements include those specified in the Public Resources Code and pursuant to CPUC rulemakings and decisions.

Table A-1: Energy Commission EPIC Reporting and Informational Requirements for Calendar Year 2018

Energy Commission Requirement	Status	Completion / Anticipated Completion Date
A. <u>Annual Report:</u> CPUC D.12-05-037, Ordering Paragraph (OP) 16 requires EPIC administrators to file an annual report each year on February 28, 2013 – February 28, 2020 with the CPUC.	This annual report has been prepared in accordance with applicable CPUC reporting requirements and will be filed with the CPUC.	2/28/19
B. <u>Service:</u> CPUC D. 12-05-037, OP 16 requires service of the annual report on all parties in the most recent EPIC proceeding; all parties to the most recent general rate case of each IOU; and each successful and unsuccessful applicant for an EPIC funding award during the previous calendar year.	This annual report will be served on all parties in the most recent EPIC proceeding; all parties to the most recent general rate case of each IOU; and each successful and unsuccessful applicant for an Energy Commission EPIC funding award during the previous calendar year.	2/28/19
C. <u>Information Availability:</u> CPUC D.13-11-025, OP 13 requires EPIC administrators, except when valid reasons exist for confidentiality, to make all data, findings, results, computer models and other products developed through EPIC available upon request consistent with the treatment of intellectual property requirements.	The Energy Commission has and will continue to respond to all requests for information in accordance with any confidentiality requirements and consistent with the treatment of intellectual property requirements. Requests can be sent to RandDProjectinfo@energy.ca.gov.	As requested
D. <u>Project Reporting:</u> CPUC D.13-11-025, OP 14 requires annual reports to include a final report for every project completed during the previous year, including a comprehensive description of the project, detailed findings and results, a summary of all data collected, and how the data may be accessed.	Table 7 in Chapter 3 of this annual report entitled Completed Electric Program Investment Plan Funded Projects in 2018, contains information regarding projects completed in 2018.	2/28/19

E.	**Awards: CPUC D. 13-11-025, OP 15 requires annual reports to identify the use of noncompetitive awards.**	Appendices B and C to this report identify the use of any non-competitive awards.	2/28/19
F.	**Project Reporting: CPUC D.13-11-025, OP 17 requires annual reports to include project-level information on the number of bidders passing the initial pass/fail screening; the rank of the selected bidder; and if the selected bidder was not the highest scoring bidder, the project status report must also explain why a lower scoring bidder was selected.**	Appendices B and C to this annual report contain project-level information on passing/failed bidders, rank of selected bidder, and an explanation if selected bidder was not highest scoring bidder.	2/28/19
G.	**Project Reporting: CPUC D.13-11-025, OP 18 requires a justification for contracts or grants exempted from competitive bidding. Additionally, CPUC D. 18-10-052, pages 22-23 states that administrators should include a detailed explanation for the use of non-competitive processes.**	Appendix B to this annual report includes a justification for any non-competitive awards for active or approved projects in 2018.	2/28/19
H.	**Annual Report: CPUC D. 13-11-025 OP 22 requires that the annual report follow the outline specified in Attachment 5 thereto.**	This annual report follows the outline as specified in D.13-11-025 Attachment 5.	2/28/2019
I.	**Annual Report: CPUC D. 13-11-025 OP 23 requires the information in Attachment 6 thereto to be included as an electronic spreadsheet to report on projects described in section 4.b. of the annual report outline from CPUC D. 13-11-025, Attachment 5.**	A project status report electronic spreadsheet detailing the information required under CPUC D. 13-11-025 Attachment 6 is included as Appendix C to this annual report and will be filed and served in electronic spreadsheet format as well.	2/28/19
J.	**Annual Report: CPUC D. 13-11-025 OP 27 requires the annual report to identify the metrics used for each project, either from CPUC D. 13-11-025 Attachment 4 or additional metrics where appropriate.**	Appendices B and C to this annual report identify the applicable metrics used for each project.	2/28/19

K.	**Information Availability: CPUC D. 13-11-025, OP 29(b) requires that, at the CPUC's request, the Energy Commission give the CPUC full access rights to all EPIC research, development, and demonstration, reports, intellectual property (IP), and data to which the Energy Commission has access, with appropriate protections for proprietary data and IP against public disclosure.**	The Energy Commission remains able and willing to comply with any CPUC requests pursuant to this requirement. Requests can be sent to RandDProjectinfo@energy.ca.gov.	As requested.
L.	**Information Availability: CPUC D. 13-11-025, page 64 encourages the Energy Commission to make its annual reports accessible to the public on its EPIC webpage and through its public advisor.**	The Energy Commission posts its EPIC annual reports on its EPIC webpage (https://www.energy.ca.gov/research/epic/documents/) and makes its reports available through its public advisor's office.	2/28/19
M.	**Project Reporting: CPUC D. 15-04-020, OP 6 requires the identification of any specific CPUC proceedings addressing issues related to each EPIC project.**	Appendix B of this annual report identifies applicable CPUC proceedings for each project.	2/28/19
N.	**Joint Project Reporting: CPUC D. 15-04-020, OP 24 requires that if there is joint IOU and Energy Commission project, the IOU shall report the project title and amount of IOU funding used for the joint project(s) and the Energy Commission shall be responsible for all other substantive reporting.**	Appendix C provides all substantive reporting for Energy Commission EPIC projects, including any joint IOU and Energy Commission projects.	2/28/19
O.	**Project Reporting: CPUC D. 15-04-020, page 53 requires that if an IOU administrator chooses to be a necessary partner on an Energy Commission EPIC project, the IOU may use its EPIC funds for in-house costs and the IOU's reports shall identify the Energy Commission project title and amount of IOU funding used, but the Energy Commission shall be responsible for all other substantive reporting as with all its other projects.**	Appendix C provides all substantive reporting for Energy Commission EPIC projects, including any projects where an IOU is a necessary partner.	12/31/2018

P.	**Annual Report: CPUC D. 18-10-052, page 66 includes the suggestion that the Energy Commission include a more detailed discussion of the pros and cons of the recommendation that the Energy Commission explore how and whether it could add more flexibility to its grant request forms and/or research planning process to be able to respond to market and technology changes that occur between project proposal and launch.**	The Energy Commission has included this suggested discussion in Chapter 1, in the Public Process and Solicitation Activities Section of this annual report.	2/28/19
Q.	**Annual Report to Legislature: Public Resources Code § 25711.5(f) requires an annual report to the Legislature.** **The annual report must contain all information as described in § 25711.5(f)(1)-(7) as follows:** **(1) A brief description of each project for which funding was awarded in the immediately prior calendar year, including name of the recipient, award amount, a description of how the project is thought to lead to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals, and a description of why the project was selected.** **(2) A brief description of each EPIC funded project that was completed in the immediately prior calendar year, including recipient name, award amount, and project outcomes.** **(3) A brief description of each funded project for which an award was made in the previous years but that is not completed, including recipient name, award amount, and a description of how the project will lead to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals.** **(4) Identification of award recipients that are California-based entities, small businesses, or businesses owned by women, minorities, or disabled veterans.** **(5) Identification of which awards were made through a competitive bid, interagency agreement, or sole source method, and any action of the Joint**	This annual report identifies the required information from Public Resources Code § 25711.5(f)(1)-(7) and will be provided to the Legislature after Energy Commission adoption at a Business Meeting.	4/30/19

	Legislative Budget Committee for each award made through an interagency agreement or sole source method. **(6) Identification of the total amount of administrative and overhead costs incurred for each project.** **(7) A brief description of the impact on program administration from the low-income and disadvantaged community allocations required under Public Resources Code § 25711.6, including any information that would help the Legislature determine whether to reauthorize those allocations beyond June 30, 2023.**		
R.	**Costs: Public Resources Code § 25711.5(g) requires justification of actual administration and overhead costs incurred, even if the total costs incurred do not exceed any CPUC caps.**	Administrative costs for EPIC for calendar year 2018 are reported and justified in Chapter 2, in the Dollars Spent on Program Administration section of this annual report.	2/28/19
S.	**Annual Report to Legislature: CPUC D.13-11-025, OP 29 requires that the annual report prepared and submitted to the Legislature pursuant to Public Resources Code § 25711.5(f), also be submitted to the CPUC (Note: Public Resources Code §25711.5(e) referenced in CPUC D.13-11-025 has since been renumbered to § 25711.5(f)).**	The annual report prepared and submitted to the Legislature pursuant to Public Resources Code § 25711.5(f) will be submitted to the CPUC upon submittal to the Legislature.	4/30/19

Source: California Energy Commission

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions [300-15-004]	
Recipient/Contractor: The Regents of the University of California on behalf of the Merced Campus	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 4/1/2016 to 3/31/2020
Program Area and Strategic Objective: Applied Research and Development S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts	
Issue: California has traditionally depended heavily on hydropower as a flexible generation source. However, a warming climate will alter the magnitude and timing of precipitation and runoff, decreasing hydropower generation. Optimization models have been used as a tool to explore ways to maximize hydropower generation and revenue. However, these models do not address the realities of a warming climate and other generation constraints, such as required downstream water temperatures or flow levels. Therefore, this project is developing an optimization model that addresses the economic and environmental constraints on hydropower generation, as well as the legal limitations on these operations.	
Project Description: This project is part of the U.S.-China Clean Energy Research Center for Water-Energy Technologies (CERC-WET), co-funded by the Department of Energy and the Government of China to partner on water-energy studies. This EPIC funded project Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions is one of three research endeavors addressing sustainable hydropower under a warming climate. The project develops an optimization model to ensure efficient hydropower operations, but this model will differ from existing models by taking into account different climate scenarios and regulatory constraints.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Prior studies of the trade-offs between electricity generation and environmental protection have been based on unrealistic optimization models that do not take real-world policy constraints, such as legal and regulatory limitations into account. The models produced by this research will for the first time create models to optimize hydropower generation that can	

take into account changes in precipitation and runoff due to a warming climate while sustaining downstream environments. These tools will inform decision-making in the context of trade-offs of electricity generation and environmental protection under a changing climate and relevant legal and regulatory constraints.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Strategies and Guidance for Climate Change Adaptation: R.18-04-019 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 3f, 4d, 5c

Lower Costs:

Hydropower generation in California represents a low cost source of energy and ancillary services that contribute minimal greenhouse gas emissions. Reduced levels of hydropower generation force investor owned utilities to rely on more expensive energy sources; costs that are passed on to the ratepayer. The model being developed in this project can assist Investor owned hydropower operators to maximize electricity generation (and revenue) while addressing environmental requirements in light of reduced stream flows due to a warming climate.

Greater Reliability:

As noted above, hydropower is a low cost source of electricity with minimal greenhouse gas emissions. Maximizing hydropower production while ensuring environmental protection in a warming climate can reduce the state's reliance on other sources of electricity that are more expensive, have greater greenhouse gas emissions and are potentially less reliable. In addition, greater penetration of renewable energy in California's electricity grid relies in part on ancillary services from hydropower. Maximizing hydropower production while ensuring environmental protection can facilitate greater penetration of renewable energy into the state's grid.

Environmental Benefits:
Hydroelectricity is a critical element of the state's electricity system because it is a low cost, flexible source of electricity. The negative effects of hydropower dams and reservoirs on downstream aquatic environments, however are well documented. A critical environmental requirement that directly affects hydropower generation is the mandated levels of water discharged downstream to maintain water quality and aquatic ecosystems. This project is developing a decision support tool to balance hydropower generation and environmental protection in a warming climate.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$114,054

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$650,000</td><td colspan="2">EPIC Funds Spent:
$5,141</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
United States Department of Energy: $12,500,000</td><td colspan="2">Leveraged Funds:
$12,500,000</td></tr>
<tr><td>Funding Method:
Non-competitive</td><td>Funding Mechanism:
Contract-Interagency agreement (UC Merced)</td><td>No. of Initial Passing Applicants/ Bidders:
N/A</td><td>Rank of Selected Applicant/ Bidder:
N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
This interagency agreement (non-competitive) leveraged significant federal funds.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement 300-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The researchers have conducted a hydropower operators survey and are analyzing the submitted data. Survey results are anticipated in January 2019. The hydrologic modeling portion of the study is just underway. This project is on schedule to be completed before the end date of March 31, 2020.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Improving Hydrologic and Energy Demand Forecasts for Hydropower Operations with Climate Change

[300-15-005]

Recipient/Contractor:

The Regents of the University of California, Irvine Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Hydropower is an extremely important source of clean electricity generation in California. Its significance will grow as it is needed to alleviate the intermittent nature of wind and solar generation units. At the same time, climate change, without proper management tools, can substantially degrade the availability of hydropower generation.

Project Description:

The main focus of this research project is to develop grid-wide forecasts of inflows and electricity demands based on ground sensors and remotely sensed data, with emphasis on the effects from temperature fluctuations on electricity demands, hydrologic conditions, and grid performance. Furthermore, the project improves the accuracy of an existing near real-time Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) product, originally developed at UC Irvine's Center for Hydrology and Remote Sensing.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The advancement of tools for hydropower scheduling/prediction will facilitate power exchanges in the electricity markets, reduce unnecessary consumption of non-renewable energy sources, and increase the reliability of energy generation. California will be the study region so that the utility companies in California have the necessary support in their decision making process.

CPUC Proceedings addressing issues related to this EPIC project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019 Renewables Portfolio Standard Program: R.18-07-003

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 3f, 5c

Greater Reliability:

More accurate and current information on streamflow will contribute to the increased confidence and higher efficiency of hydropower scheduling decisions generated by reservoir and hydropower dispatch models.

Environmental Benefits:
The improved accuracy of an existing near real-time PERSIANN tool will enable more efficient management of clean energy resources in California and will lead to improved resilience of water and energy systems to future climate change impacts. Improved hydropower management methodology will incorporate ecologically beneficial metrics for ecosystems to minimize adverse ecosystem impacts from the electricity generation.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:

Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:

$144,000</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:

$720,000</td><td colspan="2">EPIC Funds Spent:

$127,710</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:

N/A</td><td colspan="2">Match Funding:

$0</td></tr>
<tr><td colspan="2">Leverage Contributors:

United States Department of Energy: $12,500,000</td><td colspan="2">Leveraged Funds:

$12,500,000</td></tr>
<tr><td>Funding Method:

Non-competitive</td><td>Funding Mechanism:

Contract-Interagency agreement (UC Irvine)</td><td>No. of Initial Passing Applicants/ Bidders:

N/A</td><td>Rank of Selected Applicant/ Bidder:

N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

This interagency agreement (non-competitive) leveraged significant federal funds.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-15-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The research team is continuing work to develop short-term precipitation forecasting framework for key regions in California with a lead time of up to 6 hours. In addition, the team designed a new framework of deep forecasting neural networks a Generative Adversarial Network (GAN) which will allow to forecast Cloud-Top Brightness Temperature (CTBT) and facilitate the generation of the spatial-temporal information that can be extrapolated for the future events. Furthermore, team is performing sensitivity analysis on the proposed Generalized Model Tree (GMT) framework.

Researchers are currently testing multiple GMT algorithm settings for both benchmark data and real-case studies and in early 2019 will identify the optimal algorithm setting for simulating rule-based hydrologic systems (such as reservoir release simulation and operating rule reconstruction).

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack Prediction

[300-15-006]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

This project addresses three critical needs for the State of California: (1) Non-traditional waters are available in abundant quantities, but they cannot be used for most industrial, agricultural and municipal applications without the development of new approaches to manage contaminants; (2) Impacts of water conservation on power plants reliant on water for operation; and (3) Stream flow forecasts to date are considered inaccurate and pose a risk of misstating California water supply. Research is needed to illuminate which method or combination of methods will substantially improve forecasting skills and can be used in practical applications.

Project Description:

The purpose of this project is to fund research that reduces the stress on current water infrastructure in California. Research includes: (1) development of high water recovery desalination processes for non-traditional waters, (2) characterizing the potential for non-traditional water use in California, (3) development of recycled water scenarios for electricity generation, and (4) improving the characterization of California's snowpack.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Research conducted will develop flexible, integrated approaches to reduce energy use and costs associated with the use of non-traditional waters, and minimize the volume of waste water produced from their treatment. In addition, the contract will provide guidance on the "best-fit" technologies for California based on geographic area, energy resources and water quality available. Additional research will provide reliability benefits include improving water forecasting scenarios pertaining to recycled water for electricity generation and snowpack forecasting for hydropower operations.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 3a, 4a, 4c, 4d, 5a, 5c

Lower Costs:

This project could provide lower energy costs associated with the treatment of non-traditional waters.

Greater Reliability:

This project will provide greater reliability by improving forecasting methods used to predict water resource availability for electricity generation.

Environmental Benefits:

By reducing energy costs associated with treatment of non-traditional water, the project could reduce greenhouse gas emissions.

Energy Security:

This project will improve energy security by expanding on potential sources of water for cooling towers used in electricity generation. Additionally, improved forecasting will allow better water resource management for both cooling towers and hydroelectric generation.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $198,000	
EPIC Funds Encumbered: $1,130,000		**EPIC Funds Spent:** $0	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: United States Department of Energy: $12,500,000		**Leveraged Funds:** $12,500,000	
Funding Method: Non-competitive	**Funding Mechanism:** Contract-Interagency agreement (UCLA)	**No. of Initial Passing Applicants/ Bidders:** N/A	**Rank of Selected Applicant/ Bidder:** N/A

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: This interagency agreement (non-competitive) leveraged significant federal funds.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement 300-15-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project is on track. The following are some updates: a) market characterization study of non-traditional waters: preliminary literature review is complete and the team is assessing sources of nontraditional waters for the full characterization. b) recycled water scenarios are almost complete and will soon be submitted for peer review; c) characterization of snowpack and snowmelt: preliminary results have been provided for CAM; d) the real-time snow-water-equivalent diagnostic models for the hydropower plants have been completed; e) for the desalination task, the team has tracked completed tracking of bench scale membrane performance and completed an analysis for CAM review.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting

[300-15-007]

Recipient/Contractor:

California Clean Energy Fund dba CalCEF Ventures

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan 2015-2017 Triennial Investment Plan	4/20/2016 to 3/1/2023

Program Area and Strategic Objective:

Applied Research and Development

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies
S10: Advance the Early Development of Breakthrough Energy Concepts

Issue:

Clean energy entrepreneurs have trouble securing very early stage funding for potential breakthrough technologies even if those technologies would merit significant follow-on funding after the proof-of-concept is completed. Additionally, entrepreneurs with technology concepts often do not have adequate access to the mentoring, technical consulting, and business services that they need to successfully bring their technology to market.

Project Description:

The CalSEED Initiative helps develop California's next generation of clean energy entrepreneurs, providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough solutions that will benefit electric ratepayers in Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric service territories. Entrepreneurs receive funding in two stages – Concept Awards provide funding of up to $150,000 and are conducted through open solicitations; Prototype Awards provide funding of up to $450,000, but are only available to companies who have received a Concept Award.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

CalSEED addresses a critical gap in the early technology development phase where small amounts of funding can have a significant impact in bringing new ratepayer-beneficial innovations to market by providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough clean energy solutions.

APPENDIX B:
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<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy storage: R.15-03-011 [Closed] Smart grid: R.08-12-009 [closed] Smart Inverter: D.14-12-035 (in R.11-09-011) Integration of Distributed Energy Resources (IDER): R. 14-10-003</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 3e

Economic Development:
The CalSEED Initiative fills important niche in the energy innovation space by providing initial small grant funding to energy entrepreneurs to prove out their technology concept. The results can be used to attract private sector interest and funding for their energy technology venture.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$1,563,250</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$30,000,000</td><td colspan="2">EPIC Funds Spent:
$4,321,594</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
California Clean Energy Fund dba CalCEF Ventures: $1,367,604 (4.1 %)
Elemental Excelerator: $100,000 (0.3 %)
The Grant Farm, Inc: $267,591 (0.8 %)
Los Angeles Cleantech Incubator: $1,040,000 (3.1 %)
Greenlining Institute: $68,700 (0.2 %)
Umberg Zipser: $552,328 (1.7 %)</td><td colspan="2">Match Funding:
$3,396,223</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
N/A</td><td>No. of Initial Passing Applicants/ Bidders:
5 out of 7 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement 300-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The CalSEED Initiative was launched in January 2017 to provide seed grants of up to $150,000 for early-stage clean energy projects. In 2018, grants totaling over $2.6 million have been awarded to 18 entrepreneurs for a range of research projects including a phase change material that integrates into HVAC systems to reduce heating and cooling load by 25% and a magnetically stabilized liquid piston for more efficient compressed air energy storage. In total, 46 entrepreneurs have been awarded small grants under CalSEED. The first $450,000 Prototype Awards were awarded in January 2019, to the CalSEED entrepreneurs whose technologies have the strongest potential impact and commercial potential.

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Project Name:

Research Roadmap for Getting to Zero Net Energy Buildings

[300-15-008]

Recipient/Contractor:

Itron Inc., which will do business in California as IBS

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 5/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies

Issue:

The CPUCs Long-Term Energy Efficiency Strategic Plan calls for all new residential construction and all new commercial construction in California to be Zero Net Energy (ZNE) by 2020 and 2030, respectively. Additionally, AB 758 requires the Energy Commission, in collaboration with the CPUC and stakeholders, to develop a comprehensive program to achieve greater energy efficiency in existing buildings. An up-to-date gaps analysis that summarizes the current ZNE technologies available, what research needs still exist, and the market barriers hindering ZNE technology adoption was needed to inform the development of that comprehensive program.

Project Description:

Itron worked with Energy Commission staff to develop a gaps analysis that identifies, describes and prioritizes research, development, demonstration, and deployment (RDD&D) gaps that need to be addressed to achieve the state's goals for ZNE buildings in a safe, equitable and cost-beneficial manner. The gaps analysis was developed in consultation with stakeholders and subject matter experts through interviews, written comments, and public workshops.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project analyzed the most critical RDD&D gaps that need to be addressed to achieve California's goals for ZNE buildings for all new construction of residential buildings by 2020 and commercial buildings by 2030. Results of the analyses will be used to strategically target future EPIC investments in a manner that provides optimal benefits to IOU electric ratepayers, and maximizes the use of public research and development investments.

APPENDIX B:
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<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 3e
Lower Costs:
This project will help identify the most promising R&D opportunities that will benefit IOU electric ratepayers; and ensure future R&D funding opportunities leverage and do not duplicate current research underway.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$171,332</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$999,884</td><td colspan="2">EPIC Funds Spent:
$464,762</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
N/A</td><td>No. of Initial Passing Applicants/ Bidders:
5 out of 6 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement 300-15-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project was completed in May 2018. As a result of this contract, Energy Commission staff have over 60 technology briefs for high potential technologies that require more research. The technology briefs identify research gaps as well as the cost and performance targets needed for broad adoption. This contract also produced a prioritization tool that dynamically sorts the technologies based on weights assigned to priorities such as electrification, impact to the grid, and technology readiness level. The final report is being prepared for publishing on the Commission website.</td></tr>
</table>

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Project Name: Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities [300-15-009]	
Recipient/Contractor: Navigant Consulting, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan 2015-2017 Triennial Investment Plan	**Project Term:** 6/13/2016 to 3/31/2021
Program Area and Strategic Objective: Market Facilitation S18: Guide EPIC Investments through Effective Market Assessment, Program Evaluation, and Stakeholder Outreach S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses	
Issue: Emerging energy technologies sometimes fail to be commercialized because of difficulty entering the market, inability to find an optimal first customer, and inability to the address what end users actually want. To become viable in the market place, companies need market knowledge and support to develop products that meet customer needs, are cost competitive compared to existing products, and have viable path-to-market strategies that target appropriate early adopters.	
Project Description: This contract will provide market analysis that will address the barriers that hamper commercial development of emerging energy technologies. Tasks under this work authorization contract could include tracking past and current award EPIC technology solutions to monitor successes, more accurately consider future EPIC funding opportunities, inform technology gap analyses, and develop online resources. The deliverables from this project will help prioritize future Energy Commission funding towards technologies that solve the addressed issues.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Recommendations resulting from this agreement will help the Energy Commission better direct EPIC Program	

<table>
<tr><td colspan="4">technologies towards addressing customer needs and becoming widespread, commercially available products.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Integration of Distributed Energy Resources (IDER): R. 14-10-003 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 3e
Economic Development:
Market research will provide information to develop technologies, or recommend use of technologies that meet customer needs that will move the technologies to market faster. Moving technologies to market enables job creation, improved business models, and market opportunities for technology developers.
Consumer Appeal:
Market research will help better design products and research initiatives to address customer needs, increasing the attractiveness of these products in the marketplace.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$2,714,986</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$6,937,889</td><td colspan="2">EPIC Funds Spent:
$823,923</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
N/A</td><td>No. of Initial Passing Applicants/ Bidders:
3 out of 4 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order</td></tr>
</table>

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement 300-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project team has fourteen work authorization projects that are either active, in development, or have been completed. These work authorizations assist Energy Commission staff to appropriately target investments in microgrids, energy efficiency technologies, low-income/disadvantaged community research, and other topics. Additionally, a currently active work authorization will create an online platform that will facilitate tailored connections between investors, entrepreneurs, customer adopters and field test sites, and mentors and community based organizations.

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Project Name:

Research Roadmap for Advancing Technologies in California's Industrial, Agricultural, and Water Sectors

[300-15-010]

Recipient/Contractor:

Energetics Incorporated

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/20/2016 to 5/31/2018

Program Area and Strategic Objective:

Applied Research and Development

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies

Issue:

California's industrial, agriculture, and water (IAW) sectors use nearly 30 percent of all energy consumed in the state. Industry must keep operating costs low, while maintaining environmentally clean and energy-efficient operations. Agriculture is highly dependent on electricity for water-usage in both irrigation and post-harvest food processing. New analysis is needed to identify and prioritize research and development gaps for advancing energy technologies and strategies that can benefit electric ratepayers through innovation in the agriculture, industrial, and water sectors.

Project Description:

Energetics Incorporated developed a technical assessment and gaps analysis to identify the research needs for advancing technologies in the IAW sectors. They collected information from literature searches and feedback from stakeholders and subject matter experts to identify critical needs and currently available emerging technologies. Together with Energy Commission staff, the team prioritized the technologies for key research, development, demonstration, and deployment areas. Finally, they incorporated the recommendations into a research roadmap that will help inform future EPIC investments for the IAW sectors.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project analyzed the most critical R&D gaps in the industrial, agricultural, water and bioenergy sectors that need to be addressed to achieve California's goals for doubling energy efficiency by 2030. Results of the analyses will be used to strategically target future EPIC investments in a manner that provides optimal benefits to IOU electric ratepayers, and maximizes the use of public research and development investments.

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CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 3e

Lower Costs:

Identifying research gaps will help prioritize research and lower costs for end users. Establishing end-user demands for service outputs will enable research to focus on those areas in which new innovations can make the largest impact, driving down costs while increasing technology efficacy and water and energy efficiency for these sectors.

Environmental Benefits:

The industrial sector's share of California's energy consumption in 2013 amounted to nearly one quarter of the total state energy consumption, and in 2008, total irrigation consumption for California farms amounted to 7,129 million gallons. Targeted research will help mitigate the electricity and water usage of California's IAW sectors.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $122,646	
EPIC Funds Encumbered: $647,728		**EPIC Funds Spent:** $546,723	
Match Partner and Funding Split: Energetics Incorporated: $16,860 (2.5 %) TSS Consultants: $10,000 (1.5 %) Taylor Biomass Energy, LLC: $1,500 (0.2 %) Renewable Oil International LLC: $750 (0.1 %)		**Match Funding:** $29,610	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** N/A	**No. of Initial Passing Applicants/ Bidders:** 3 out of 4 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement 300-15-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project ended in May 2018. Energetics conducted additional surveys and webinars to get stakeholder input on high-impact emerging technologies, the barriers to market entry for these technologies, as well as actions that can support market entry, and the success indicators. Feedback from 249 surveys and 19 webinars was analyzed and incorporated into a final research roadmap. The roadmap identifies critical technology gaps, possible solutions, and analysis for six major technology areas: industrial processing, industrial facilities, industrial power, agriculture, bioenergy, and water and wastewater. Energetics recommended a total of 123 energy-saving technologies that were prioritized for the six technology areas. Of these recommendations, 42 technologies are still in the RD&D stage. The roadmap will help inform the Energy Commission's future EPIC investments for the IAW sectors.

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Project Name: California Commercial End-Use Survey [300-15-011]	
Recipient/Contractor: ADM Associates, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/15/2016 to 3/30/2020
Program Area and Strategic Objective: Market Facilitation S18: Guide EPIC Investments through Effective Market Assessment, Program Evaluation, and Stakeholder Outreach	
Issue: A commercial end-use survey (CEUS) is used by energy researchers, including the Energy Commission's Demand Analysis Office, to calculate estimates used in energy forecast models, including: commercial floor space, annual whole building energy use, end-use fuel saturations, and annual whole-building hourly load profiles. Researchers at universities and national labs have indicated interest in having energy-use forecasts with more granularity, disaggregated to the local or regional service territory level. The end-use survey must be properly designed to fully support this level of granularity in order to increase the confidence of the results, and thus, the accuracy of the energy forecasts.	
Project Description: The Energy Commission conducted a CEUS in 2006, since then the energy landscape in California has changed dramatically including the deployment of advanced energy efficiency and renewable generation technologies. This project is updating the CEUS while adding additional granularity by (1) developing a methodology to conduct a survey of the characteristics of commercial utility customers that will serve as a baseline and support the Energy Commission's work on the demand forecast, (2) implementing the survey, and (3) providing an unbiased, comprehensive analysis of the data. When completed, the CEUS will provide a clearer picture of commercial energy end-use which will allow better strategic targeting of policies and incentives which will help facilitate the commercial success and market adoption of technologies, strategies, and other innovations.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The CEUS will provide a more disaggregated sampling of the state's end-uses in the commercial sector, than was historically collected. This level of granularity will lead to more accurate energy forecasts which can assist in keeping rates low as forecasts are used to	

<table>
<tr><td colspan="4">determine infrastructure needs in long term procurement planning by the CPUC. Furthermore, the data can assist the state in achieving the energy efficiency reduction goals outlined in Senate Bill 350 by supporting the identification and accurate characterization of opportunities for demand-side management, energy efficiency program planning, load shifting, and demand response.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1c, 2a, 5c
Lower Costs:
This project can support reduced costs by leading to a more accurate demand forecast for the commercial sector. This can provide more certainty on base-line end-use consumption and provide a better input into the CPUC's Long-Term Procurement Planning efforts so that only the generation that is truly needed will be planned and procured.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$3,426,324</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$7,990,063</td><td colspan="2">EPIC Funds Spent:
$0epc-15-030
epc</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
ADM Associates, Inc.: $100,893 (1.2 %)</td><td colspan="2">Match Funding:
$100,893</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
N/A</td><td>No. of Initial Passing Applicants/ Bidders:
4 out of 4 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement 300-15-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

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Update:

ADM negotiated non-disclosure agreements with the three California electric IOUs, to receive access to customer billing data necessary to conduct the survey. They also finalized the research plan, survey instrument and data collection protocols. The team began collection efforts with a sample pretest, to ensure the survey instrument and protocols worked, and made refinements to them as necessary. Surveyors were then trained and began collecting data in each of the IOU service territories in a staggered fashion, to optimize resources throughout the state. During various stages of the collection process, ADM performed monitoring and quality control of the data being submitted by the surveyors to: 1) identify incorrect or "out of range" entries, 2) analyze the data received, and 3) resolve sites with unusually high inconsistencies. Data collection will continue through 2019.

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Project Name:

California Investor-Owned Utility Electricity Load Shapes

[300-15-013]

Recipient/Contractor:

ADM Associates, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/29/2016 to 12/31/2018

Program Area and Strategic Objective:

Market Facilitation

S21: Inform Investments and Decision-Making Through Market and Technical Analysis.

Issue:

Informed electricity generation and transmission decisions require accurate hourly load projections for electricity that account for the impact of demand-side measures and changing customer trends. The Energy Commission, in its current analysis, applies hourly load profiles based on historic patterns to the demand forecast to develop projected hourly usage. These load profiles, however, do not take into account any changes to the mix of end-uses that would be brought on by emerging trends or expected demand-side policies.

Project Description:

This project will develop analysis to characterize existing and future electricity load in the service territories of Pacific Gas & Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company that will inform the Energy Commission's demand forecast. This information will, by including a mix of emerging energy trends and demand-side innovations, be used to identify and target opportunities to further reduce cost, improve safety, and improve reliability through clean energy technology research, development, deployment, and market facilitation opportunities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

DER technology has advanced significantly over the past decade and current loadshapes used to inform the Energy Commission's demand forecast do not account for the current and future deployment of demand-side innovations. Developing improved loadshapes will provide an accurate assessment of the contributions of clean energy technologies to reducing peak demand, integrating renewable energy, and maintaining electricity system reliability as the deployment of clean energy technologies and strategies increases over time.

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This information will be used to improve the Energy Commission's demand forecast and analysis, and identify and target opportunities for future EPIC research funding to further reduce cost, improve safety, and improve reliability.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed]

Applicable Metrics: CPUC Metrics- 1c, 5c

Greater Reliability:

This project can lead to reduced costs by leading to a more accurate demand forecast for typical usage of appliances and equipment, building type, and implemented demand-side policies. This can lead to more certainty on base-line end-use consumption and provide a better input into the CPUC's Long-Term Procurement Planning efforts so that only the generation that is truly needed, will be planned and procured.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $430,673
EPIC Funds Encumbered: $1,147,406	**EPIC Funds Spent:** $464,770
Match Partner and Funding Split: ADM Associates, Inc.: $58,330 (4.8 %)	**Match Funding:** $58,330
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** N/A	**No. of Initial Passing Applicants/ Bidders:** 5 out of 5 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-15-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

This project concluded in 2018. The Recipient developed updated baseline end-use load profiles and well as new load profiles characterizing electric vehicle use, photovoltaic use, and additional achievable energy efficiency. The Recipient also developed an updated version of the Hourly Electric Load Model. The Energy Commission's Energy Assessments Division will use this information to develop an annual peak forecast for the California Energy Demand (CED) forecasts, develop monthly peak forecasts for resource adequacy and CED forecasts, develop hourly forecasts to support peak shift analysis for annual peak forecasts, analyze various impacts, including AAEE and electric vehicles, to measure their impact on load shapes, and to provide end-user and other load shapes to outside stakeholders and other analysts.

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Project Name:

Distributed Energy Resources (DER) Roadmap

[300-17-003]

Recipient/Contractor:

Navigant Consulting, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/29/2018 to 12/31/2019

Program Area and Strategic Objective:

Market Facilitation

S21: Inform Investments and Decision-Making Through Market and Technical Analysis.

Issue:

To help ensure that EPIC funds are strategically focused and sufficiently narrow to make advancements on the most significant technological challenges, new analysis is needed that identifies and prioritizes RDD&D gaps to achieving California's goals for integrating high penetrations of distributed energy resources (DER). This roadmap focuses on assessing the technology cost and performance of emerging technologies that best facilitate greater penetration of DER into the grid, as well as on identifying the data needed to advance DER policy and increase the availability of financing.

Project Description:

This project develops, in consultation with stakeholders and subject matter experts, a research roadmap that identifies, describes, and prioritizes key RDD&D needs to enable high penetration of distributed energy resources (DER). The roadmap will assess current status of DER in California; assess current research efforts, including those at the state and federal level; identify performance and cost targets and research needs; estimate rates for technology performance improvement, cost reduction, and adoption; develop methodology for prioritizing research needs in the near-, mid-, and long-term; apply methodology to research gaps to prioritize near, mid-, and long-term research needs; identify critical cost and performance indicators of success and methodology to estimate research benefits. Finally, the roadmap will Identify type and amount of data needed to advance DER policy and availability of DER financing, particularly for low-income customers; conduct public workshops; and document the roadmapping process.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This contract will fund efforts to strategically and effectively target future EPIC investments to maximize the use of public research and development investments. The resulting roadmap will identify and prioritize research on the most critical RDD&D technology gaps to enable

transformation of the grid that increasingly integrates high-penetration of DERs that are needed to be address to achieve California's energy goals. The results of the analysis will provide further detail in the integration into utility planning and operational policies that are critical to the technological improvements and physical connections to the grid.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Self-Generation Incentive Program: R.12-11-005 Energy storage: R.15-03-011 [Closed] Distribution Resources Plans (AB 327): R.14-08-013 Demand Response (DR): R.13-09-011 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 2a

Lower Costs:

This project will identify the areas of EPIC-funded research that will provide the greatest benefits at the lowest cost to ratepayers.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $252,120
EPIC Funds Encumbered: $499,065	**EPIC Funds Spent:** $0
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** N/A	**No. of Initial Passing Applicants/ Bidders:** 5 out of 5 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-17-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

APPENDIX B:
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Update:

The kickoff meeting was held on July 11, 2018. Subsequently, two separate Technical Advisory Committee (TAC) Meetings were held on September 11, 2018, and November 5, 2018 to seek inputs and feedback from TAC members on technical topic areas, literature sources, and metric development. The research team is in the process of finalizing the Literature Review component and is working on the development of the Technical Assessment of the DER technologies. Navigant anticipates hosting the first public workshop in Q1 2019 to seek comments on the draft Technical Assessment.

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Project Name:

Measuring Innovation Progress to Guide Future Investment: Evaluation of EPIC Benefits Methodology

[300-17-004]

Recipient/Contractor:

Industrial Economics, Incorporated

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/29/2018 to 2/16/2021

Program Area and Strategic Objective:

Market Facilitation

S21: Inform Investments and Decision-Making Through Market and Technical Analysis.

Issue:

The primary goal of the EPIC program is to provide benefits to electric ratepayers of California investor-owned electric utilities. However, evaluating ratepayer benefits of EPIC-funded projects presents many challenges. First, the EPIC project portfolio is diverse and complex, spanning many different technology areas in various stages of research. Second, there is often a significant lag between a research investment and the realization of tangible benefits, as it often takes several years for an innovation to be adopted in the market or utilized in practice. Finally, some of the intangible benefits of research such as knowledge gained are important, but difficult to quantify.

Project Description:

This project will provide guidance and independent analysis to develop a robust, standardized methodology to evaluate the electric ratepayer benefits attributable to EPIC-funded projects based on best-in-class methods, data, and analytical tools. This methodology will help the Energy Commission better understand how well the EPIC program is meeting its goals and removing barriers to further implementation of advanced technologies to meet the state's energy and climate policy goals.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the state's statutory energy goals by standardizing the assessment of benefits to ratepayers of EPIC-funded projects.

CPUC Proceedings addressing issues related to this EPIC project:

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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 3e
Economic Development:
This project will help the Energy Commission better understand the benefits to ratepayers resulting from projects funded by the EPIC program and will help the Energy Commission make more efficient and effective use of future EPIC funds.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$1,716,826</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$3,000,000</td><td colspan="2">EPIC Funds Spent:
$49,280</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
N/A</td><td>No. of Initial Passing Applicants/ Bidders:
3 out of 3 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement 300-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project is completing its characterization of the EPIC program portfolio and reviewing information specific to each research area, including solicitations, grant agreements, and research roadmaps. The project team has held multiple meeting with EPIC research area leads to assess specific benefits priorities and challenges and to develop research-area specific logic models. The project team is conducting benefits literature review to explore available methods, data, and tools that can be incorporated into the methodology. The first major deliverable from this project to recommend improvements to the benefits methodology of the EPIC program is scheduled for June 2019.</td></tr>
</table>

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Project Name: Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation [300-17-005]	
Recipient/Contractor: Energetics Incorporated	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 6/4/2018 to 11/29/2019
Program Area and Strategic Objective: Market Facilitation S21: Inform Investments and Decision-Making Through Market and Technical Analysis.	
Issue: This Research Roadmap initiative arises from the need to help achieve California's forward-leaning, legislated goals to increase energy efficiency, ramp up the generation of renewable power, and reduce emissions contributing to global climate change. Therefore, EPIC requires an RD&D portfolio that strategically targets the right mix of scientific and technological advancements, sets and meets appropriate milestones, and leverages available resources to accelerate the delivery of effective products and practices. Broad market uptake of these new technologies is essential to attain state energy and environmental goals.	
Project Description: This project aims to develop a research roadmap to strategically frame research priorities, potential partnerships, and critical technology milestones to support EPIC portfolio decisions and accelerate progress toward more cost competitive, flexible and reliable renewable energy generation, operation, and storage.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This Research Roadmap aims to strategically frame research priorities, potential partnerships, and critical technology milestones to help inform EPIC RDD&D portfolio decisions and accelerate progress toward more cost competitive, flexible and reliable renewable energy generation, operation, and storage. A roadmap is the right tool for laying out RDD&D pathways. A robust roadmap considers a spectrum of technology complexity, the current state of the art, rapid expansion of scientific knowledge, competition for research and development (R&D) funding, dynamic customer expectations, and the high cost and risk of R&D.	

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CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]

Applicable Metrics: CPUC Metrics- 2a

Lower Costs:

Cost is a significant barrier to greater renewable energy penetration of the California grid. This Research Roadmap aims to strategically frame research priorities, potential partnerships, and critical technology milestones to help inform EPIC RDD&D portfolio decisions and accelerate progress toward more cost competitive, flexible and reliable renewable energy generation, operation, and storage.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $86,365
EPIC Funds Encumbered: $338,059	**EPIC Funds Spent:** $0
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** N/A	**No. of Initial Passing Applicants/ Bidders:** 4 out of 4 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-17-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

The project team is working on the development of the technical assessment of the grid connected renewable energy and storage technologies within California, which includes a literature review and feedback from subject matter experts in renewable energy systems. The project team has put together a list of experts in wind energy, solar energy, geothermal, small hydropower, bioenergy, storage and renewable integration from universities, research institutions, and public and private sectors, and has conducted more than 30 interviews with experts to prepare the assessment.

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Project Name:

Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart

[EPC-14-001]

Recipient/Contractor:

Itron Inc., which will do business in California as IBS

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/15/2015 to 6/29/2018

Program Area and Strategic Objective:

Applied Research and Development

S4: Develop Emerging Utility Scale Renewable Energy Generation Technologies and Strategies to Improve Power Plant Performance, Reduce Costs, and Expand the Resource Base

Issue:

Solar is an intermittent resource, and accurate prediction of when and how this fluctuating renewable resource can be used is essential for grid operators. Increasingly accurate forecasting tools have been developed in recent years, but they have yet to be fully implemented into grid operations to optimize operations for high-penetration solar. Furthermore, none of the California ISO load forecast models include and capture the impact of behind-the-meter solar PV on measured loads. The limitation of integrating state-of-the-art solar forecasts into net-load forecasts is based on the absence of estimates to determine the value of utilizing improved PV solar forecasts into grid operations.

Project Description:

This project aimed to reduce the operational uncertainty in both PV and net load forecasts by producing high accuracy forecasts and linking them to net load forecasts at finer time intervals. This increased accuracy in estimation and incorporation within net load forecasts will enable better integration of intermittent PV generation in California and lead to substantial savings in the associated wholesale energy market costs. The results of this agreement contribute to reduced operational uncertainty behind the Duck Chart by producing high accuracy solar generation forecasts for utilities and the CAISO, and linking these generation forecasts to methods for forecasting net loads at higher temporal resolution. This increased fidelity and connection to net load forecasts will provide critical insights to better manage the rapidly evolving grid in California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project showed that improvements in solar and net load forecasting methods can provide positive financial impacts in the scheduling and procurement of electricity in the wholesale electric market within the State. The results of this research have shown that, just in the

period covered by this analysis, the potential savings to all stakeholders would have been on the order of $9 million. With further growth in solar and improvements in integrating behind the meter solar into the California ISO net load forecasts, the team anticipates it can achieve even greater cost reductions. This research sets the groundwork for further research on developing a framework to optimize the use of alternative forecasts by the California ISO into its net load forecast. It may be possible to develop a framework for choosing when to use the alternative forecast to optimize its value to all stakeholders.

CPUC Proceedings addressing issues related to this EPIC project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 4a, 5c

Lower Costs:

Improved net load forecasts reduce the cost of grid regulation required to cover increasing load forecast errors. By reducing the percentage error by just 0.1 percent, the California ISO and California ratepayers can save more than $2 million per year. Therefore, the estimated annual savings resulting from use of the improved forecasts vary from $1.5M to over $7M. As the installed capacity of behind-the-meter PV increases, the annual savings will likely increase. The BTM solar forecast model provides the load model a more accurate prediction, which reduces the cost of operating the electric grid.

Greater Reliability:

The project increases system reliability by significantly increasing the accuracy of solar PV forecasts and the associated net load forecasts. This integration of state-of-the-art solar forecasts into net-load forecasts further enables the growth of PV because it solves the problem that behind the meter (BTM) solar causes to the load model. BTM forecast makes the electric grid more robust, such that it is prepared to adopt distributed generation at any future rate.

Environmental Benefits:

Reduced requirements for regulation services and spinning reserves will help reduce GHG emissions by an estimated 2.7 million tons per year through reduced use of natural gas fired peaker plants.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$268,243
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$998,926	$741,596

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<table>
<tr><td colspan="2">Match Partner and Funding Split:
Itron, Inc., dba IBS: $451,062 (31.1 %)
Clean Power Research: $2,400 (0.2 %)</td><td colspan="2">Match Funding:
$453,462</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
18 out of 18 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project incorporated several forecast improvements by advancing methods for determining BTM system specifications and shading based on measured production inputs, integrating irradiance measurements to improve aerosol optical depth and cloud albedo aspects, and by incorporating near real-time metered PV generation data to fine-tune fleet forecasts of both grid-connected and BTM PV solar. Researchers evaluated three alternative model approaches for extending the CAISO load forecast framework and present the alternative load forecast frameworks for incorporating BTM solar PV forecasts. The study showed that improvements in solar and net load forecasting can provide positive financial impacts in the scheduling and procurement of electricity in the wholesale electric market within the State. The potential savings would have been on the order of $9 million just in the covered period.</td></tr>
</table>

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Project Name:

Investigating Flexible Generation Capabilities at the Geysers

[EPC-14-002]

Recipient/Contractor:

Geysers Power Company, LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/5/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S4: Develop Emerging Utility Scale Renewable Energy Generation Technologies and Strategies to Improve Power Plant Performance, Reduce Costs, and Expand the Resource Base

Issue:

Electric system operators are concerned about large quantities of intermittent energy sources being reliably integrated onto the grid. While geothermal energy has served to provide a steady level of baseload energy, reducing impacts of intermittent energy will require quickly dispatchable sources of generation with the flexibility to ramp up or down as needed. Modifying geothermal operations to provide this flexibility would be valuable to system operation. However physical and operational issues are associated with providing such flexible generation from geothermal facilities.

Project Description:

This project is investigating how the operation of Geysers geothermal facilities may be modified in order to address the greater demands imposed on the grid by the significant addition of intermittent resources. To do so, the project is developing an integrated model that simulates the effects of providing flexible operation on the reservoir, wells, pipelines, and power plants. The model is being tested at isolated wells, pipeline and power plant sites, and then at a cross-tied location, to determine the effects of flexible operation on the larger steam field. Results will be used to identify risks to structure and operations. Management and mitigation strategies needed to address specific flexible generation objectives will be identified and tested at a variety of representative problem areas. An evaluation of management strategies and costs will be developed to provide flexible generation and ancillary services.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The modeling work performed under this project resulted in successful development and application of a simulation-optimization framework for the optimal control of a steamfield under load curtailment. The framework can be used for different purposes. Specifically,

response surfaces can be generated and visualized, providing valuable insights into the influence of interactions between control parameters. Steam wells with wellbore or corrosion risk problems can be addressed individually as needed, for example setting a minimum target flowrate on a well and adjusting automatically for changing pipeline pressures. More testing and development is needed in this area. Corrosion monitoring and mitigation is an ongoing major challenge. Strategies for dealing with corrosion will build upon current operating practices and R&D efforts.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Resource Adequacy (RA): R.11-10-023 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 4a, 5a, 5b

Lower Costs:

Currently, geothermal power plants operated by GPC provide benefits to support Resource Adequacy and RPS goals, while providing voltage support and scheduled reactive power. However, these plants can provide some increased cost-effective flexible capacity as long as it meets its PPA contract terms. The lowest sustainable MW level (P-min) at the existing plants is 280 MW, which is a 60% reduction from nominal 700 MW baseload levels. Turbine bypass additions at two power plants allow reductions in P-min on those units to zero net MW. This drops the potential P-min total to 246 MW for increased flexibility.

Greater Reliability:
The primary benefit to ratepayers from this project is to help sustain ongoing safe reliable operation of the Geysers geothermal field while adding some incremental amounts of flexible capacity and avoid any significant damage to its facilities. This project studied the existing capabilities and limits to provide flexible capacity in terms of frequency, magnitude, duration and power plant ramp rate.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$0
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$3,000,000	$2,082,595
Match Partner and Funding Split:	**Match Funding:**
Geysers Power Company, LLC: $1,615,560 (21.9 %) Multiple Mechanical Subcontractors: $2,071,190 (28.1 %) Multiple Equipment Suppliers: $659,223 (9.0 %) Reservoir Engineering Contractor: $16,400 (0.2 %)	$4,362,373

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<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
18 out of 18 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project conducted a study to investigate flexible electrical generation capabilities at The Geysers. The overall objective was to define steam-field and power plant operating constraints and find ways to increase flexible generating capabilities. An integrated numerical model was developed to predict, study, and ultimately design strategies for flexible power generation. Field testing and modeling results show that steam well and pipeline corrosion is a major constraint on steam-field operations. High Chloride wells generally have Corrosion Mitigation Facilities (CMF) installed and are maintained at full flow. Upgrades installed during this study provided an incremental increase in existing flexible generation capabilities. Results from this study will guide economic evaluations and future capital improvements needed to expand current Geysers flexible generation capabilities.</td></tr>
</table>

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Project Name:

Low- Cost Thermal Energy Storage for Dispatchable CSP

[EPC-14-003]

Recipient/Contractor:

The Regents of the University of California on behalf of the Los Angeles Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/15/2015 to 3/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S4: Develop Emerging Utility Scale Renewable Energy Generation Technologies and Strategies to Improve Power Plant Performance, Reduce Costs, and Expand the Resource Base

Issue:

There is a growing problem facing the California electric grid as more and more electricity is being generated by renewable resources such as wind and solar. While there are many benefits to these resources, by their nature, they are 1) unable to match power production to usage, and 2) highly variable and/or intermittent in their production when compared to traditional electricity sources. A possible solution to these issues is increased use of thermal energy storage (TES) with concentrating solar power (CSP). Unfortunately, current TES technologies are prohibitively expensive and difficult to dispatch.

Project Description:

The purpose of this project is the development and demonstration of a cost-optimal, robust, and low-cost thermal energy storage (TES) fluid, elemental sulfur. Use of sulfur as a TES fluid will enable overall low system costs, long lifetime, and scalability for a wide range of concentrating solar power (CSP) applications and temperatures.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will develop a low-cost thermal storage fluid, elemental sulfur, which enables overall low system costs, long lifetime, and scalability for a wide range of concentrating solar power applications.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Energy storage: R.15-03-011 [Closed] Demand Response (DR): R.13-09-011

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Applicable Metrics: CPUC Metrics- 2a, 3a, 3b, 3h, 4a, 4b

Lower Costs:

This project aims to reduce the cost of TES to $15/kWh. Compared to current state-of-the-art, this leads to a decrease in LCOE from 3 cents/kWh to 0.4 cents/kWh, providing $0.66 billion to $1.32 billion in annual savings depending on CSP penetration.

Greater Reliability:

Use of TES allows excess harvested solar energy to be stored during the day to be used during peak or non-solar hours, which increases dispatchability of renewable resources and provides load shifting.

Economic Development:

Assuming 5% to 10% penetration of CSP and deployment beginning in 2017, the 10-year net present value of this technology is estimated to be between $680 and $906 million.

Environmental Benefits:

Assuming 5% to 10% penetration of CSP and 1010 MWh of TES by 2020, significant GHG and criteria air pollutant reductions would be achieved: 2791 ton/MW of CO2, 37 ton/MW of SO2, 5 ton/MW of NOx, and 2.4 ton/MW of CO.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $198,528	
EPIC Funds Encumbered: $1,497,024		**EPIC Funds Spent:** $692,224	
Match Partner and Funding Split: Southern California Gas Company: $300,000 (16.7 %)		**Match Funding:** $300,000	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 18 out of 18 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project has made significant progress including performing detailed heat transfer modeling and simulation, laboratory-scale material compatibility experiments, and laboratory-scale thermal battery testing. Results from the laboratory-scale (10 kWh capacity) system were very promising. The system was successfully operated at high temperature (600 degrees Centigrade) over multiple thermal cycles and demonstrated higher energy density and faster dynamic response (amount of time to charge and discharge) compared to conventional molten salt technology. A pilot-scale (30 kWh capacity) thermal battery system has been designed, built, and is being field tested using actual concentrating solar power as of December 2018. Testing the system in a real-world environment is critical to proving it can work with actual solar energy input.

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Project Name:

Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid

[EPC-14-005]

Recipient/Contractor:

The Regents of the University of California, San Diego

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/15/2015 to 3/15/2018

Program Area and Strategic Objective:

Applied Research and Development

S4: Develop Emerging Utility Scale Renewable Energy Generation Technologies and Strategies to Improve Power Plant Performance, Reduce Costs, and Expand the Resource Base

Issue:

The variable nature of solar power is of concern to electric grid operators in California. If short-term solar variability cannot be predicted or reduced, the integration cost of solar power increases through investment in energy storage or regulation capacity by the grid operator. Especially at the microgrid and distribution feeder level, the geographic diversity is less available and solar generation is the primary contributor to net load variability, causing voltage issues affecting service quality and reliability.

Project Description:

This project aimed to integrate high-accuracy solar forecasting to optimize the operation of distributed energy resources, and utilize the value of solar forecasting in utility grid operations to improve grid reliability, reduce ratepayer costs and increase safety. The objectives were to apply forecasts to inform control and scheduling decisions for distributed energy resources with emphasis on energy storage and electric vehicle charging control at warehouse photovoltaic clusters in the LA-Orange-Riverside-San Bernardino-San Diego Counties as well as the UCSD microgrid.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The uncontrollable generation of renewable energy sources, such as solar photovoltaics poses numerous challenges to the electric grid. The large growth of electric vehicles (EV) has potential to exacerbate those challenges due to increases in load, especially at inopportune times. However, the flexibility of scheduling EV charging around forecasted PV production provides a solution to this problem. Furthermore, the project improved solar energy forecast accuracy by 10% over the existing persistence forecast method for 10 minute ahead to

optimize the operation of distributed energy resources. It will mitigate the concerns of electric operations over the variable nature of solar power that contributes to net load variability, causing voltage issues affecting service quality and reliability.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Smart grid: R.08-12-009 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1c, 4a, 5c

Lower Costs:

The project showed that utility customers who use solar forecasting and smart electric vehicle charging could achieve a 67 percent reduction in energy costs over the year. Monthly peak demand was reduced by 63 percent on average. This tool contributes to a better utilization of existing generation resources and transmission and distribution (T&D) assets, unbundling of EV driver behavior or economical preferences, and lower consumer cost per kWh. The energy cost reduction is estimated at $6.8 million/year per 100 MW of DERs.

Greater Reliability:

The project integrates high-accuracy solar forecasts to distributed energy resources (DERs) and provide the grid operators and balancing authorities the information needed to optimize operations leading to a more responsive and reliable operation of the grid. This integrating tool contributes to a peak load reduction of about 37MW per 100 MW of DERs.

Economic Development:

The tool and strategies developed in the project have the potential of boosting the economic activities associated with the optimized use of distributed solar energy resources and the reduction of grid net load variability. The economic benefits are the improvements in system operation efficiencies, and the creation of skilled people and local jobs that contribute to the advancement toward a green economy. Optimal scheduling in comparison with conventional for one year of operation of a fleet of 49 electric vehicles in SCE territory results to a decrease of 65% in peak power demand, 13% in ratepayer costs and 63% in total customer costs, and lead to 100% PV self-consumption.

Environmental Benefits:

Optimized use of distributed solar energy technologies will lead to reduced water consumption and greenhouse gas (GHG) emissions in the energy generation sector. Furthermore, adoption of electric vehicles (EV) as alternative to fixed storage devices will contribute to reduced materials wastes and air pollutant overall. The GHG and NOx Reductions are estimated at 52,194 and 3.1 MT/year per 100 MW of DERs, respectively.

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<table>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$157,282</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$999,984</td><td colspan="2">EPIC Funds Spent:
$726,345</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
San Diego Gas & Electric Company: $250,000 (12.5 %)
Strategen: $93,614 (4.7 %)
Itron, Inc. dba IBS: $483,032 (24.2 %)
University of California, San Diego, San Diego Supercomputer Center: $173,338 (8.7 %)</td><td colspan="2">Match Funding:
$999,984</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
18 out of 18 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The utility customers who use solar forecasting and smart EV charging could achieve a 67% reduction in energy costs over the year, reducing monthly peak demand by 63%. This study reveals that using aggregated vehicle load large enough to absorb the solar output on the studied circuit is years in the future. The studied circuit showed that connected PV output created an energy valley of 64.5 MWh. Using a typical commuter PEV requiring 7 kWh means that roughly 9,200 vehicles must be connected during the solar output period to create an adequately sized energy sink to absorb the full amount of this oversupply. The executive order B-48-18 will improve the perspectives for EV charging and grid net load balancing in California. But at 929,000 commercial buildings in California, Oregon, and Washington, even 250,000 chargers will fall short of the amounts required in this example.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

High-Fidelity Solar Power Forecasting Systems for the 392 MW Ivanpah Solar Plant (CSP) and the 250 MW California Valley Solar Ranch (PV)

[EPC-14-008]

Recipient/Contractor:

The Regents of the University of California, San Diego

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/15/2015 to 1/15/2019

Program Area and Strategic Objective:

Applied Research and Development

S4: Develop Emerging Utility Scale Renewable Energy Generation Technologies and Strategies to Improve Power Plant Performance, Reduce Costs, and Expand the Resource Base

Issue:

Accurate forecasting tools for solar irradiance and solar power output have the potential to increase the reliability of California's energy supply, and the ability to optimize the dispatch of energy sources by reducing the uncertainty created by fast-changing weather conditions. High fidelity solar forecasting is an enabling technology for increasing solar penetration into the grid. However, there is a lack of well-developed forecasting models for components of solar irradiance that are critical to concentrating solar technologies, especially Direct Normal Irradiance (DNI) and Plane of Array (POA), and current high-density ground telemetry is still expensive for many solar power plants.

Project Description:

The purpose of this project to develop and validate tools capable of monitoring and forecasting DNI and POA irradiance and the power generation accurately, from 5 minutes out to 72 hours in the future, mainly at the Ivanpah Solar Thermal plant, but also at the California Valley Solar Ranch (CVSR) plant. The project also included the development of tools for predicting wind speed, which affects the heliostats' deployment, and the improvement of the power generation forecast via Resource-to-Power Model (RTP) for Ivanpah (CSP) and CVSR (Tracking PV) plants. The goal of this system is to reduce uncertainties associated with operation, regulation and scheduling.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project introduced a new generation of forecasting methods that fill in a technology gap in prediction DNI, POA irradiance and solar power generation from PV tracking and CSP. This critical need is evident by the relative scarcity of DNI forecasting algorithms discussed in scientific literature and the absence of DNI information from the majority of NWP models. The

development of a network of low-cost sensors for distributed monitoring at California Valley Solar Ranch (CVSR) provides a solution to the need for high-density ground telemetry at low cost. The devices provide an unprecedented level of irradiance sensor density, which will be used to develop a new generation of solar forecasting methods. Short-term forecast using sky imagers and distributed data from sensor network improved forecasted data and prepared CVSR for the California ISO intra-hour market.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] California Solar Initiative: R.12-11-005

Applicable Metrics: CPUC Metrics- 1c, 4a, 5c

Lower Costs:

The project developed and validated models that lead to lower operation costs and consumer cost per solar kWh due to increased ability to absorb short-term ramps and maintain solar production, better utilization of ancillary generation, better integration of solar assets with utility and ISO operations, and decreased down-time tripping events due to solar variability. Researchers tested an alternative to CAISO's centralized solar forecasting for CVSR and prepared the power plant for the CAISO real-time market. Results indicates a 67% reduction in the monthly imbalance and eliminates the forecasting fee of $0.10 per MWh.

Greater Reliability:

The tools developed in this project result in greater reliability by developing high-fidelity models that increase the accuracy of solar energy forecasting to decrease the number of forced outages and associated ancillary reserves. The forecasting models achieved significant improvement in accuracy for all time horizons. The DNI improvements were 10.2, 40.3 and 43.9 percent of intra-hour, intra-day and day-ahead models, respectively. The POA improvements were 34.1, 38.6, and 62.4 for intra-hour, intra-day and day-ahead models, respectively.

Economic Development:

The forecasting tools developed in this project will help economic development by reducing solar power plant operating cost by more than 10% and having the ability to substantially affect the effective solar capacity in California. These forecasting tools enhanced capacity of utility-scale CSP power plants due to improved prediction of resource and power output and contribute a better integration of solar assets with utility and ISO operations. Additionally, the project has created skilled jobs and prepared talented people with research skills for the California job market.

Environmental Benefits:

The project will result in GHG emission reductions by decreasing the uncertainty associated with solar power generation to diminish the need of fossil fuel generation.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$168,624</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$999,898</td><td colspan="2">EPIC Funds Spent:
$695,921</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
NRG Energy, Inc.: $460,000 (26.1 %)
Itron, Inc. dba IBS: $304,019 (17.2 %)</td><td colspan="2">Match Funding:
$764,019</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
18 out of 18 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project demonstrated that the forecasting accuracy for DNI and POA irradiance across all time-scales (intra-hour, intra-day, day-ahead) can be improved using forecasting models that blend local and remote telemetry. The project results demonstrated the importance of having a rich set of input data to improve forecasting. This effect was more important for the intra-hour time scale, in which multiple solar sensors, sky images, high-resolution satellite images, are essential to reduce forecasting errors. The tools developed were used in two very distinct testbeds (Ivanpah and CVSR) to predict irradiance and power generation. In both cases, the forecasting accuracy was improved relative to baseline models. The models were successfully applied to other locations, showing that they can be used in other grid-connected solar farms. The final report was submitted and it is in review process.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Optimizing Radiant Systems for Energy Efficiency and Comfort

[EPC-14-009]

Recipient/Contractor:

The Regents of the University of California on behalf of the Berkeley campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Application of radiant systems has increased in recent years, as they provide an opportunity to achieve energy and peak demand savings compared to conventional all-air systems. Despite this growth, controls and operation of radiant systems can be challenging due to a lack of familiarity within HVAC design and operation professions. Radiant systems are being designed, installed, and operated with only limited guidance and inappropriate tools to assist designers and building operators. New and/or revised definitions and methods for the design, sizing, and control of effective radiant cooling and heating systems are needed.

Project Description:

This project develops new design and operation tools for radiant cooling and heating systems in order to provide standardized guidance for radiant systems in commercial buildings. The agreement includes full-scale laboratory experiments, whole-building simulations, development of simplified models for radiant system controls, validation of these new methods in field studies, occupant satisfaction surveys, and an update to Title-24 for radiant systems. The project is expected to produce: 1) a simplified tool for calculating the cooling load and cooling capacity of a radiant slab system, including calculation methods with significant direct solar radiation, 2) a simplified online operational tool for radiant slab systems, and 3) updates to the Title 24 Alternative Calculation Method Reference Manual to enable improved modeling capabilities of radiant systems.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Radiant systems can be an integral part of ZNE and other advanced high performance buildings and reduce energy and peak energy use and cost compared to conventional HVAC systems.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 4a

Lower Costs:

The technology could reduce energy consumption and costs in California commercial buildings by as much as 844 GWh/yr and $165M/yr.

Environmental Benefits:

The technology could reduce CO2e emissions due to reductions in energy use for cooling California commercial buildings. Based on the estimated annual electric savings, implementation of radiant systems could reduce CO2e emissions by up to 200,000 metric tons.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $450,466
EPIC Funds Encumbered: $2,939,964	**EPIC Funds Spent:** $2,097,811
Match Partner and Funding Split: Center for the Built Environment - UC Berkeley: $239,194 (7.4 %) Price Industries: $60,000 (1.9 %)	**Match Funding:** $299,194
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Field study reports for all three sites were submitted. The project team has completed all major data collection and monitoring activities. The project team is finishing a software tool for modeling radiant systems and is expected to be completed in early 2019. The draft final report is anticipated in early 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation

[EPC-14-010]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	3/30/2015 to 6/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Increasing the albedo (solar reflectance) of a building's envelope reduces solar heat gain in the cooling season. Raising envelope albedo can also cool the outside air, boosting energy savings and demand reduction by decreasing the air temperature difference across the building envelope. Lowering urban surface and air temperatures improves air quality by slowing the reactions that produce smog, and delays global warming through negative radiative forcing ("global cooling"). Current data are insufficient to accurately predict savings impacts for different cool wall materials; which prevents cool wall technology from being included in building standards or utility rebate programs.

Project Description:

This project (a) quantifies the energy savings, peak demand reduction, urban cooling, and air quality improvements attainable from cool walls in California; (b) assesses the performance of existing cool wall technologies, develops innovative cool wall solutions, and (c) facilitates collaboration among government agencies, utilities, and industry to create a cool-wall infrastructure that includes application guidelines, a product rating program, incentives, and building code credits.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project is advancing scientific knowledge by quantifying the potential benefits of cool walls, assessing the performance of existing and prototype cool wall technologies, and developing innovative cool wall solutions. High wall albedo can be attained with a reflective coating (e.g., paint or stucco) or cladding. Cool wall products available today include light-colored paints that reflect up to 80% of sunlight when new, but may lose reflectance as they soil; and darker cool colored paints that come in a wide palette, but typically reflect less than 50% of sunlight when new. This project will provide information to building owners, facility

managers, and the paint industry on the direct and indirect energy and environmental benefits of solar reflecting walls, assessing and advancing available and emerging cool wall tech
CPUC Proceedings addressing issues related to this EPIC project: Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs
Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 4a, 5d Lower Costs: Solar-reflective cool walls reduce absorption of sunlight by the building envelope, which may decrease cooling load in warm weather and increase heating load in cool weather. Impacts of cool walls on annual HVAC energy use depend on climate, wall construction, wall orientation and other factors. Decreasing cooling load will directly reduce customer bills for air conditioning. It could also reduce electricity generation capacity procurement costs when incorporated into the Load Forecast. Project results show that cool walls can reduce whole-building annual HVAC energy use 3.0% to 25% in single-family homes, 0.5% to 3.7% in medium offices, and 0.0% to 9.0% in stand-alone retail store. Environmental Benefits: By reducing space conditioning load, annual fossil power plant emissions could be reduced, with consequent reductions in greenhouse gas emissions as well as nitrogen oxides and sulfur dioxide. Public Health: Reduced electrical load would lower the risks of grid failure and potential loss of air conditioning, and morbidity/mortality on hot, sunny days. Cool walls will also reduce urban air temperatures, helping mitigate extreme heat events and improving air quality.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $908,941
EPIC Funds Encumbered: $2,500,000	**EPIC Funds Spent:** $2,500,000
Match Partner and Funding Split: 3M: $7,600 (0.2 %) BEHR: $33,000 (1.1 %) Metal Construction Association: $88,100 (2.8 %)	**Match Funding:** $610,800

<table>
<tr><td colspan="2">PPG Industries: $100,000 (3.2 %)
Saint-Gobain: $90,000 (2.9 %)
Tex-Cote: $10,000 (0.3 %)
Valspar: $270,000 (8.7 %)
Sherwin Williams: $12,100 (0.4 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Intellectual Property

Pre-existing intellectual property identified in agreement EPC-14-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project has been completed. The findings from this project indicate that cool walls can reduce whole-building annual HVAC use by up to 25% in single-family, 3.7% in medium offices, and 9% in stand-alone retail stores. The final report will be published in January 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

From the Laboratory to the California Marketplace: A New Generation of LED Lighting Solutions

[EPC-14-011]

Recipient/Contractor:

Regents of the University of California, Davis

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/1/2015 to 3/19/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Adoption of lighting emitting diode (LED) lighting for general illumination is poised to be the largest advancement in lighting building efficiency during the 21st century. A variety of market actors have introduced LED products and made performance claims that have set the technology up with unrealistic performance expectations. LED manufacturers have focused on research into efficacy cost at the expense of quality, resulting in an influx of poor quality LED products with minimal options such as color and dim ability. This has led to a lack of consumer satisfaction, and resulting minimal market share for LED products in key indoor residential and commercial applications.

Project Description:

This project focuses on the design and development of innovative LED lighting solutions for three key general illumination product categories. These solutions are a best-in-class medium, screw-base replacement lamp, linear tubular light emitting diode (TLED) replacement lamps and spectrally optimized, dedicated LED luminaires. Product design requirements are based on consumer light quality and functional performance preferences determined through a series of unique laboratory-based consumer preference and product characterization studies.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project could improve understanding of metrics and test procedures associated with LED quality and performance, increase lamp manufacturer's ability to comply with future energy codes and standards and produce good quality LED products and increase consumer acceptance and satisfaction of LED lamps.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 4a
Lower Costs:
The LED products developed could result in direct electricity and peak demand reduction and cost savings for consumers by an estimated 30%.

Environmental Benefits:
As lighting constitutes 20-30 percent of the electrical use in buildings, the development and deployment of the developed LED products could reduce electricity use and CO2 emissions.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$557,072</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,995,187</td><td colspan="2">EPIC Funds Spent:
$1,691,723</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Regents of the University of California, Davis - California Lighting Technology Center: $5,000 (0.2 %)</td><td colspan="2">Match Funding:
$5,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
California Lighting Technology Center - UC Davis: $5,000</td><td colspan="2">Leveraged Funds:
$5,000</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The recipient completed a lamp characterization report which included a survey on consumer interests in LED lamps and controls, information on lighting performance and functional experiment on three classes of LED lamps. Preliminary results indicate that consumers are concerned about energy savings, and those who participated in the study want higher CRI lamps even though the lamps produce 13% less light output. The full report is posted at https://cltc.ucdavis.edu/. The recipient is working with manufacturers interested in collaborating on new LED lamp development such as optics, quality and architecture. The recipient is partnering with UC Irvine to study consumer acceptance of LED lamp prototypes to assess color, flicker, noise and overall performance for healthcare applications. The draft final research report will be available in February 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Comparing Attic Approaches for Zero Net Energy Homes

[EPC-14-012]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	3/30/2015 to 12/31/2018

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

As homes approach zero net energy (ZNE), the energy impacts of some emerging construction strategies need investigation to determine their energy impacts. One strategy is to seal and insulate the attic that contains the home's thermal distribution system. However, there are questions regarding the level of air sealing and insulation needed, the impact on attic humidity and potential for attic or roof damage, and the overall impact on annual building energy use.

Project Description:

The project focused on the performance of different attic assemblies and their associated heating, ventilating and air conditioning (HVAC) systems. Field measurements of attic and HVAC system performance were conducted in two new high performance homes in California with sealed and insulated attics. One home was built to be about 30 percent better than Title 24 and the other is a ZNE home. The attic insulation approach involved a new lower-cost approach using blown insulation that does not use expensive spray-foam. The results of the measurements are used directly to provide technical support for potential changes to Title 24 and provide information to contractors and builders on sealed and insulated attic performance and alternative approaches.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will lead to technological advancement by offering alternative construction techniques for sealing and insulating attics, compared to conventional methods. The alternative technique involves the use of sealed attics and could lead to electricity savings and peak demand savings when compared to conventional duct systems, and also increase occupant comfort. The recipient is working with building developers on these new techniques which will contribute to achieving ZNE goals for new construction. The techniques can also be applied to home retrofits with HVAC equipment.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a

Lower Costs:

The technologies and construction techniques could result in significant reduction in heating and cooling energy cost which is estimated to be 15 percent for new construction and 25 percent for retrofits.

Environmental Benefits:

A 15 percent reduction in energy use associated with unvented attics could result in reductions in greenhouse gas emissions. Assuming 10 percent of new homes are built with the attic approaches recommended in this study, approximately 5,000 metric ton of CO2e will be reduced compared to standard construction.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $563,439	
EPIC Funds Encumbered: $1,000,000		**EPIC Funds Spent:** $1,000,000	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Staff is reviewing the final report and a final project presentation occurred on 12/19/18. The Fresno test home was monitored continuously from September 2016 to the end of April 2018, and the Clovis test home was monitored from June 2017 through mid-May 2018. The Fresno home exceeds California Title 24 energy performance requirements by 30%, while the Clovis home is designed as a net zero-energy home. Over 100 sensors were installed per home, monitoring temperature, relative humidity, heat flux, surface condensation, moisture and HVAC energy use. An improved version of a sophisticated and mature model called Register Capacity (REGCAP) was used to extend results to all of California's 16 climate zones. Preliminary results indicate an average of 18 percent savings in HVAC energy use using these approaches.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Very Low-cost MEMS-based Ultrasonic Anemometer for Use Indoors and in HVAC Ducts

[EPC-14-013]

Recipient/Contractor:

The Regents of the University of California on behalf of the Berkeley campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	8/25/2015 to 3/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Air movement in buildings impacts comfort, ventilation, air quality, occupant health and safety, and is responsible for about half of the energy used for heating, ventilating and air conditioning buildings. Currently, the way air velocity and air flow are measured is inaccurate, failure-prone, and often expensive. Airflow within rooms is almost never monitored because of the expense, power draw, and fragility of existing sensors. Air flow in ducts, and in other HVAC equipment are often out of calibration. The result is that building control systems cannot predict energy flows accurately.

Project Description:

This project develops and tests prototype room and duct anemometers that are low-cost, low power, accurate, calibration-free and compact. The anemometers are wireless, able to be inexpensively installed in existing buildings, can operate on a battery for years and communicate wirelessly via the internet to the building's control system. The technology is expected to save energy by using collected data to correct wasteful HVAC malfunctions that result in inefficient systems and uncomfortable buildings.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The ability to accurately control airflow with these low cost sensors can expand the comfortable temperature setpoint range in air-conditioned buildings, such as allowing the setting higher indoor temperatures while still being comfortable. This can facilitate more efficient operation of building HVAC systems, resulting in an estimated savings of 183 GWh/yr and 52,000 metric tons CO2e/yr.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 2a, 3a, 4a

Lower Costs:

The estimated savings are $26 million per year in reduced energy bills for building owners/occupants, assuming technology applicability in 25-75% of buildings, a 10-15% potential savings on all HVAC related energy use, and market penetration of 5-25%. Due to potentially less equipment operation time, equipment life could be extended along with reduced operations and maintenance costs.

Greater Reliability:

HVAC systems can be turned off when measured airflow indicates ventilation requirements have been met, resulting in improved system operation, power reliability, and reduce grid impacts.

Increase Safety:

Safety of occupants is improved when ventilation air is accurately measured, as inaccurate pressure sensors often lead to reduced zone ventilation rates, and malfunctioning outside air dampers often do not provide sufficient minimum outside air.

Economic Development:

This project will provide work for 17 individuals in California for a total of 42,683 hours over the course of 3.5 years. The mature technology has the potential to create high tech manufacturing jobs in California.

Environmental Benefits:

Estimated reduction of 52,000 metric tons of carbon dioxide/yr, assuming technology applicability in 25-75% of buildings, a10-15% potential savings on all HVAC related energy use, and market penetration of 5-25%.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $595,177
EPIC Funds Encumbered: $2,488,964	**EPIC Funds Spent:** $1,406,967
Match Partner and Funding Split: Price Industries: $40,000 (1.5 %) BAF Technologies Inc.: $45,000 (1.6 %)	**Match Funding:** $249,000

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Chirp Microsystems, Inc.: $120,000 (4.4 %)
Center for the Built Environment - UC Berkeley: $14,000 (0.5 %)
Vigilent: $30,000 (1.1 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project is nearing completion. The team has developed prototypes of both a duct air flow sensor, and a room air flow sensor, both of which were demonstrated at an industry advisory board meeting in October 2018. The team is testing the prototypes and the final report is being reviewed.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Direct Current as an Integrating and Enabling Platform

[EPC-14-015]

Recipient/Contractor:

Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/15/2015 to 6/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Despite the potentially significant benefits of direct current (DC) and alternating (AC)-DC hybrid building systems over traditional AC-powered electric systems, DC and AC-DC buildings face a number of technical and institutional barriers to their adoption. Policymakers and building developers who wish to explore opportunities and pathways to incorporate DC and AC-DC hybrid systems, lack independent baseline information and tools to inform their policy-making, designs and deployment decisions. As a result, they are hesitant to move forward on promoting and implementing the early adoption of DC and AC-DC hybrid systems.

Project Description:

This project evaluates DC and AC-DC hybrid applications to determine market segments where projects are technically and economically feasible. The research covers existing and new buildings. For the market segments identified, the Team is developing and piloting tools to help building developers incorporate these systems into their building designs. The tools include DC and AC-DC hybrid design guidelines, and design templates.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The potential energy savings and interoperability advantages of DC and AC-DC hybrid systems are estimated to be significant, especially for zero net energy (ZNE) buildings that integrate on-site renewable energy with battery storage and electric vehicle (EV) charging. Prior research estimates energy savings potential of 10% to 30% for DC-powered ZNE buildings that incorporate storage and or EV charging. This project will help accelerate the adoption of DC and AC-DC hybrid applications by compiling existing knowledge, identifying standards and technology gaps, designing tools and identifying a path forward to help ensure successful outcomes for DC and AC-DC hybrid applications in key market segments from which these systems can scale.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs:

Use of DC power will avoid unnecessary power conversions, improving efficiency, and eliminating the need for some conversion equipment. Total energy savings are estimated to be $800 million over a ten-year period, assuming full penetration of DC distribution in all buildings that install PV between 2015 and 2024.

Greater Reliability:

DC power has a long history of reliability in the telecommunications sector. Similar improvement is expected for DC power use in buildings. DC power use in buildings will improve reliability by eliminating failure in power conversion equipment.

Environmental Benefits:

Reduction in energy use could result in reductions in greenhouse gas emissions. Also, eliminating the need for some conversion equipment could reduce the cost of PV, storage and other related systems.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $495,365	
EPIC Funds Encumbered: $1,000,000		**EPIC Funds Spent:** $1,000,000	
Match Partner and Funding Split: California LMCC IBEW-NECA: $50,000 (4.5 %) EMerge Alliance: $50,000 (4.5 %)		**Match Funding:** $100,000	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project is complete. Results indicate that no technology breakthroughs are needed to make DC power distribution a viable option for zero net energy buildings. There are, however, many barriers to the adoption of DC power, with product availability and cost as the most significant ones. There also is a general unfamiliarity with DC power in the building community, from designers to code officials, contractors, tradespeople, maintenance staff, building owners, occupants, and policy makers. The recipient indicates that there is a real need for DC power market development in the form of product standards, building and fire codes that explicitly account for DC systems, DC specific design practices, improved trade familiarity, and a wider variety of DC ready products in a range of product categories, feature sets and capacities. The final report will be published in January 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Cost- and Energy-Efficient Attic Designs for California Homes

[EPC-14-016]

Recipient/Contractor:

BIRAenergy

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/29/2015 to 6/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

In 2013, new California home construction totaled 85,310 units; 36,878 single family units and 48,432 multifamily units. An estimated 90% of the single family homes had the heating, ventilation and air conditioning (HVAC) equipment and ductwork (ducts) in the temperature extremes of ventilated attics. California homes place the HVAC and ducts in the attic to avoid using valuable living space. Placing ducts in the attic makes duct installations easier and less expensive. However, this practice results in wasted energy estimated at about 4.8 TWh and significant carbon emissions estimated at 1.2 million metric tons of equivalent carbon dioxide emissions (CO2e) each year.

Project Description:

This project evaluates, tests and refines two different attic designs in California homes and recommends the best approaches to home builders addressing cost-effectiveness and energy-efficiency. The baseline will be the current energy efficiency code practices for ventilated roof attics with no additional attic insulation and ducts within the attic that comply with the current energy code (2013) requirements for ducting.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Methods to improve the efficiency of building envelopes have included sealed, insulated attics as well as standard vented attics but are in limited use in the market today. However, these approaches add considerable cost to builders under current practices. The research team is employing new and novel installation methods and materials, which include low cost fiberglass insulation with boxed netting and integral vapor retarder, that have the potential for energy savings on par with ducts in the conditioned space, but at a cost similar to current construction practices.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 4a
Lower Costs:
The project could lower energy cost to ratepayers by developing attic assemblies that allow ducts to perform as if they were located in the "conditioned space" and reduce HVAC energy costs without adding cost to builders. Pilot work on the attic designs have demonstrated that these approaches can potentially be cost neutral to ratepayers. Assuming a market penetration of 73% of the current single-family market, new construction with these designs could potentially recoup the costs to ratepayers within a single year.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$228,148</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,000,000</td><td colspan="2">EPIC Funds Spent:
$774,029</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Owens Corning: $265,000 (20.9 %)</td><td colspan="2">Match Funding:
$265,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The recipient instrumented three existing homes in the City of Rio Vista with the following attic approaches: Vented with R-38 on the ceiling, Sealed with box netted R-38 under roof deck, and vented with R-38 on the ceiling and R-19 under roof deck. The monitoring started in August 2018. Unfortunately, the grant expired on June 30, 2018. The Energy Commission staff and the recipient are exploring options for obtaining the monitored data and results for the homes and concluding the project.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Developing Flexible, Networked Lighting Control Systems That Reliably Save Energy

[EPC-14-017]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/1/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

The greatest difficulty in deploying advanced and intelligent lighting control systems is the lack of multi-vendor interoperability and standard user interface elements. Building owners may have multiple lighting systems that cannot be controlled by whole-building automation because of different user interfaces, and replacing working lighting systems in order to use whole-building automation is costly.

Project Description:

The recipient is developing low-cost lighting components with open communication interfaces, that allow seamless integration into whole-building control and automation systems. The project targets future California Building Energy Efficiency Standards (Title 24), and establish methods by which the site-specific configuration and operation of networked lighting controls systems can be effectively addressed, and more easily implemented in the marketplace.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The research focus is on how low cost sensing and distributed intelligence can enhance energy efficiency and enable distributed points of controls that result in greater energy savings and more accurate energy reporting. The research will result in the design and development of a new innovative desk lamp with localized sensing and user control of overhead ambient lighting. This innovative technology alters the lighting retrofit landscape by inexpensively enabling highly granular lighting control at the occupant's fingertips (previously only zone-level control existed), to control overhead lighting. In addition, this technology can be enhanced with sensors to measure occupants circadian lighting exposure to enable system control to ensure human health and productivity is optimized while maximizing energy efficiency attributes.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a

Lower Costs:

The technology could reduce energy consumption and costs associated with lighting energy use in commercial buildings by an estimated 40%. Additionally, one of the goals is to develop low cost lighting components which could facilitate easier implementation into the marketplace.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $216,162
EPIC Funds Encumbered: $1,875,000	**EPIC Funds Spent:** $1,875,000
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 6

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The project is on track to complete all deliverables. Standard data models for connected lighting systems were developed. Communication protocols, methodologies, metrics and control testing for the outcome-based lighting systems are complete. Testing of Enlighted's networked lighting control system is occurring at FlexLab, and will compare reported data types. Draft proposed content for user interface standards was circulated to industry in September 2018 for comments. Draft final report anticipated January 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Development and Testing of the Next Generation Residential Space Conditioning System for California

[EPC-14-021]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Cooling and heating buildings to achieve comfortable temperature and humidity levels accounts for a large portion of the electricity bills for Californians. The building sector awaits the promise of novel energy-efficiency technologies that will decrease operating costs of space-conditioning equipment and increase comfort. Many of the technologies that deliver efficiency exist, but are not integrated into a single HVAC system, nor are they optimized for California climates.

Project Description:

This project is designing and testing a residential heat pump space-conditioning system at 3 homes across California. The advanced efficiency solutions integrated into the HVAC system will include: variable-capacity compressor and variable-speed fans using state-of-the-art inverter technology; integrated ventilation to harness fresh air for "free cooling;" intelligent dual-fuel technology to decrease energy cost and empower consumers to choose between electricity and natural gas; zonal control to prevent conditioning of unoccupied rooms; demand-response interactivity to grid flexibility and reliability; advanced fault detection and diagnostics to ensure proper installation, operation, and maintenance; and alternative refrigerants for improved operation and significant reductions in the potential for global warming.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will develop a climate optimized HVAC system that includes advanced energy efficiency features integrated into a single unit. The technology could reduce electricity use, demand and costs, enhance occupant comfort, and allow the use of alternative refrigerants that reduce the potential for global warming.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project: Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed]			
Applicable Metrics: CPUC Metrics- 1e, 1f, 1g, 1h, 4a Lower Costs: This technology is estimated to reduce electricity usage by 725 GWh per year, or approximately $108 million annually. In addition, the fault detection and diagnostic feature could help reduce operation and maintenance costs on HVAC equipment. Greater Reliability: The technology is estimated to reduce peak demand by 1.5 GW which could reduce impacts to the grid. Environmental Benefits: The technology is estimated to reduce greenhouse gas emissions by 193,000 metric tons of CO2 emissions annually due to reductions in energy use.			
Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $1,072,105	
EPIC Funds Encumbered: $2,993,005		**EPIC Funds Spent:** $1,437,829	
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $322,281 (9.7 %)		**Match Funding:** $322,281	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 8

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: There are three test sites for this project, one in each electric IOU territory. Data collection is underway and will continue to be collected until early 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

The Lakeview Farms Dairy Biogas - To - Electricity Project

[EPC-14-022]

Recipient/Contractor:

ABEC #3 LLC, dba Lakeview Farms Dairy Biogas

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

The reasons in favor of dairy-based bioenergy generation systems are compelling; however, many factors hinder their financing, development, demonstration, and deployment. Important factors are the economics and that dairy farmers lack expertise in electricity generation and are not interested in becoming energy managers. California Bioenergy and some dairy farmers in the San Joaquin Valley are pursuing an ownership structure, in which multiple dairies pool their interest across multiple biogas electricity and fuel production projects. This model could be used for California dairy farms interested in dairy biogas systems, but concerned about the economic and technical risks.

Project Description:

ABEC #3 LLC, DBA Lakeview Farms Dairy Biogas is installing and demonstrating an innovative covered lagoon digester system that will process dairy manure into biogas to generate renewable electricity for export to the electricity distribution grid. This particular project is located near 11 other dairies and will help launch the state's first "hub-and-spoke" dairy digester cluster by preparing the 1 MW generator platform to accept 2 MWs of future capacity potentially utilizing biogas from neighboring dairies and providing a means to off-take gas for vehicle fuel use. This hub and spoke approach was initially proposed in a case study prepared for the USDA on the economic feasibility of dairy digester clusters in California. The idea is to allow the dairies to benefit from the aggregation of capital investment and reduce operation and management costs by centrally locating the generators and associated electrical equipment.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will significantly reduce methane emissions and generate renewable electricity helping to achieve the State's GHG emission reductions and renewable electricity goals.

Demonstrating the effectiveness of the innovative hub and spoke model could lead to the development of more California dairy digester biogas-to-electricity and biogas-to-fuels projects. The improved digester design will decrease dairy operating costs and provide valuable co-products, such as nutrient-rich, more absorbable irrigation water.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 3a, 4a, 4e

Lower Costs:

The project aims to demonstrate a system that ultimately reduces dairy digester project costs by participating in electricity energy markets and taking advantage of economies of scale from the planned hub and spoke build-out.

Environmental Benefits:

The project will deploy new renewable power generation and destroy methane gas currently vented into the atmosphere. The double-lined lagoon enhances groundwater protection by minimizing leaching of manure into underlying groundwater. The project estimates the Carbon Offsets that would likely be generated over the project's 10 year crediting period at 144,090 tonnes CO2e gross based on ARB's Livestock Protocol.

Consumer Appeal:

The project will improve odor control, through hydrogen sulfide removal, an issue important to the dairy employees and benefits the local community.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $32,107
EPIC Funds Encumbered: $4,000,000	**EPIC Funds Spent:** $3,733,835
Match Partner and Funding Split: ABEC #3 LLC, dba Lakeview Farms Dairy Biogas: $4,500,000 (52.9 %)	**Match Funding:** $4,500,000
Leverage Contributors: N/A	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	19 out of 23 bidders	Group 3: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

California Bioenergy LLC Lagoon Digester Systems. Propriety designs, processes, expertise and operational procedures include, for example, developed digester systems to support gas storage, energy storage, flexible liquid and gas volumes, co-digestates, clustered generator configurations, H2S reduction, improved effluent value, farmer savings, and integration with fuel programs.

Update:

The project broke ground in fall 2016 and construction is complete. A TAC was held in October 2017 followed by a CPR in November. The project accepted a PG&E 20-year Power Purchase Agreement and began testing in fourth quarter 2017 with full operation and data collection commencing in the first quarter of 2018. A ribbon cutting event was held in February 2018. The project is operating and continuing data collection for a year.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits

[EPC-14-023]

Recipient/Contractor:

Eos Energy Storage, LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/27/2015 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S8: Integrate Grid Level Energy Storage Technologies and Determine Best Applications That Provide Locational Benefits

Issue:

Distributed energy storage can provide fast-responding grid services and much needed locational capacity to integrate renewable energy. Despite this great potential, the high cost and short life of current commercial energy storage technologies make their use largely uneconomical. Moreover, safety and energy density limitations have prevented wide-spread deployment of energy storage on a distributed basis. There is minimal experience in integrating these storage systems with traditional utility infrastructure. Safer and more cost-effective energy storage options need to be developed for integration into the electrical grid with input from the electric utilities.

Project Description:

Eos is performing pilot testing of a 125 kW/375 kWh AC-integrated energy storage system consisting of approximately 140 Eos Znyth (Trademark) battery modules. The system is being installed at PG&E's testing facility in San Ramon, CA. System performance is being characterized against a variety of use cases including peak shaving, ancillary services, load following, and frequency regulation. Eos is modeling a portion of PG&E's distribution network to create simulated grid conditions that will allow for dynamic testing of the battery storage system.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Eos is the only company offering a zinc hybrid cathode battery, under the trademark name Znyth. This is an aqueous, zinc-based battery technology that is inherently safer than competing technologies. This technology is non-flammable and non-toxic. In addition to being backed by UL- and ISO-certified quality assurance and control, the manufacturing process involves no toxic or hazardous materials. This demonstration will provide information and

data to assess the value and cost savings of utility-scale battery energy storage when interconnected to the grid.
CPUC Proceedings addressing issues related to this EPIC project: Energy storage: R.15-03-011 [Closed] Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003
Applicable Metrics: CPUC Metrics- 1c, 1i, 2a, 4a, 5b Lower Costs: This project will determine any cost savings by testing this battery system and determining how well the battery can cost-effectively provide the grid with peak shaving, ancillary services, load following, and frequency regulation. These markets and services may provide a revenue stream for energy storage users. Greater Reliability: This project will contribute to more efficient battery storage which will ensure greater reliability for the grid as a whole and increase energy storage use. Increase Safety: This zinc-based battery technology is safer than competing technologies because it is non-flammable and non-toxic. The manufacturing process does not involve toxic or hazardous materials; this also makes transportation and handling much safer.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $691,504
EPIC Funds Encumbered: $2,156,704	**EPIC Funds Spent:** $1,517,558
Match Partner and Funding Split: Eos Energy Storage, LLC: $1,117,607 (33.6 %) Electric Power Research Institute, Inc.: $50,000 (1.5 %)	**Match Funding:** $1,167,607
Leverage Contributors: N/A	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	35 out of 38 bidders	Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Major milestones accomplished in 2018 include battery installation, system commissioning, system operation and monitoring, and data review for Eos' first generation system. Based on key learnings from the Generation 1 system, Eos developed the Generation 2 system which will be installed and commissioned for testing and evaluation in 2019. The Generation 2 system will be their commercial deployment model.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Modular Biomass Power Systems to Facilitate Forest Fuel Reduction Treatment [EPC-14-024]	
Recipient/Contractor: West Biofuels LLC	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 4/13/2015 to 3/31/2018
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable	
Issue: Community-scale bioenergy infrastructure is critical to support sustainable management of the forested landscape to protect communities, watersheds, and energy infrastructure from the catastrophic wildfire. As identified in the California Bioenergy Action Plan (2012), the utilization of forest waste to promote sustainable forest management practices is of critical importance to the State and to utility ratepayers. While biomass power has existed in the forested settings in California with the deployment of large-scale direct combustion power plants, mostly built in the 1980's, community-scale biomass conversion technology has yet to be successful largely due to cost and performance issues.	
Project Description: This project develops and tests a modular biomass gasification system that can be rapidly deployed to communities across California to promote and support fire-safe management activities.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project is driving innovation in the bioenergy market for forest residue conversion to renewable grid power by advancing the modular gasification technology system design and integration with a high-efficiency lean-burn engine. The modular system has the potential to reduce the cost and increase the benefits of forest fuel reduction projects in high fire risk regions of the state. The project sought a technological solution to support California goals including healthy forest management, protection of electricity infrastructure, and production of renewable electricity.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1c, 4a

Lower Costs:

The rotary gasifier and ORC generator configuration has a levelized cost of energy of $242/MWh, resulting in the more favorable business case and economic performance of the four systems evaluated in the project. If biochar is included in the equation, the bioenergy sector has the potential to generate renewable power that is cost competitive with intermittent renewables. With a market hovering above $1.00/kg, long-term production of high-quality biochar could reduce electricity generation prices to $40/MWh.

Increase Safety:

Ratepayers can benefit from community-scale forest gasification technologies because of the ability to more proactively manage the forested landscape. Conventionally wildfire risks are mitigated by treatment of forest landscape and removal of excess biomass. Community-scale bioenergy provides an opportunity to support local and sustainable fire management activities that can protect forest lands and allows local outlets for the material collected as a by-product of existing and planned fire safe management activities.

Economic Development:

It is estimated that approximately 4.9 jobs are created per MW of bioenergy generation. Most bioenergy facilities are, and will be, sited in rural areas that are experiencing significant economic hardship. Unlike traditional direct combustion technologies, gasification systems also produce biochar, an important co-product that has the potential to contribute with the cost competitiveness of the bioenergy sector.

Environmental Benefits:

This project will help with sustainable forest management by removing overgrowth and dead trees from the surrounding forested area, preserving forest carbon sequestration and protecting key watersheds.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$330,466
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$2,000,000	$1,507,302

APPENDIX B:
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<table>
<tr><td colspan="2">Match Partner and Funding Split:
West Biofuels, LLC: $510,000 (18.7 %)
TSS Consultants: $18,754 (0.7 %)
Soper-Wheeler Co. LLC: $8,160 (0.3 %)
Christiana Darlington: $3,000 (0.1 %)</td><td colspan="2">Match Funding:
$730,148</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 27 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project yielded important results that did not support the initial hypothesis that the recipient’s CircleDraft gasification system was appropriate for the California market. However, the project did result in the development of a more robust modular system (rotary gasifier integrated to an Organic Ranking cycle (ORC) generator) that addressed critical technical challenges experienced with the initial system including material flow issues associated with forest material, associated producer gas output and quality fluctuations, and high engine generator maintenance requirements. Based on testing done with match funds, the rotary gasifier + ORC generator configuration is ready for a commercial technology demonstration in a California forest sector community.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Mass-manufactured, Air Driven Trackers for Low Cost, High Performance Photovoltaic Systems

[EPC-14-025]

Recipient/Contractor:

Sunfolding Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable

Issue:

Solar tracking has taken off in the last few years, but current trackers have run out of options for cost reductions. The state of the art designs use a traditional approach of motors, gearboxes, and bearings. These components are manually assembled with high-cost materials, leading to limits in cost reduction and scale up. Further, this approach includes many points of failure and has high maintenance costs.

Project Description:

The project aimed to install and test a 300 kW photovoltaic solar system with air driven trackers. Two key technical innovations were demonstrated. First, the use of mass-manufacturing for the drive system results in an extremely low cost structure and very low part count. Second, only tubing is connected to each actuator, removing requirements for outdoor wiring or individual control hardware. The research involved collecting six months of performance data for the solar PV tracking technology.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The PV solar tracking technology tested and validated in this project will result in ratepayer benefits of reduced cost of energy and increased energy supply reliability. The air driven trackers not only reduce the direct product cost to the customers, but also simplify every step in the project lifecycle (i.e., development, construction, and operation). The reduced cost of energy will be achieved by the innovative solar tracking technology that adds 15-25% more power over fixed tilt systems at a cost that is well below the cost of current solar trackers. The increases in energy supply reliability will be achieved by delivering additional power that occurs in the late afternoon to the grid.

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CPUC Proceedings addressing issues related to this EPIC project:

California Solar Initiative: R.12-11-005

Applicable Metrics: CPUC Metrics- 2a, 3b, 4a

Lower Costs:

Sunfolding technology lowers the end-to-end cost of a solar plant. The modular design enables flexible site layouts with a tracker that fits into odd-shaped sites, which can add up to 20% more capacity on a site. This significantly lowers fixed costs. Traditional trackers use more than 21 components while Sunfolding's tracker uses only three. By using fewer components, the system is installed 2x faster and with less chance for re-work or error. This technology can reduce maintenance and maximize durability in the field. There are 95% fewer maintenance locations compared to traditional trackers and the regular maintenance regime is limited to changing an air filter on the compressor annually.

Greater Reliability:

Tracked solar PV systems increase the yield of a solar plant by 15–25% over fixed tilt systems. This provides additional benefits at the grid level. Unlike fixed tilt systems, tracked systems deliver the same amount of power regardless of the sun's position and time of day. By capturing west-facing power in the late afternoon, tracked PV systems can soften, though not eliminate, ramping requirements.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $157,497	
EPIC Funds Encumbered: $1,000,000		**EPIC Funds Spent:** $636,136	
Match Partner and Funding Split: PV Evolution Labs: $265,000 (12.2 %) Sunfolding, Inc.: $906,565 (41.7 %)		**Match Funding:** $1,171,565	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 25 out of 27 bidders	**Rank of Selected Applicant/ Bidder:** Group 4: Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Sunfolding successfully installed the 300kW PV tracker in the field, which is currently operating at PVUSA. The field was fully instrumented and analysis of system performance data demonstrated that it meets or exceeds industry standards for tracking accuracy, uptime, and availability, which are key metrics to meeting solar industry bankability requirements. Sunfolding's tracker accuracy was calculated based on standards in IEC 62817. The analysis involved data cleaning, correcting wind speed to meet standards, dividing data into high and low wind speed based on a 4 m/s threshold, and filtering data based on nautical twilight. The project team also evaluated the pneumatic system using pressure sensors and a series of tests in the field and in simulations, which have strongly improved the understanding of the system and effect of changes in pressure and position on tracker performance.

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Project Name: Low Cost Biogas Power Generation with Increased Efficiency and Lower Emissions [EPC-14-028]	
Recipient/Contractor: InnoSepra, LLC	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/1/2015 to 3/29/2019
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable	
Issue: Conventional biogas purification technologies used for biogas upgrading have high capital and operating costs, and have not been used commercially in power generation applications. Innovative technologies and physical sorbents to effectively remove multiple impurities from raw biogas in a single step prior to power generation would enable a significant reduction in the capital and operating costs and energy required for biogas purification. The use of purified biogas for power generation can provide significant cost, efficiency and environmental benefits in combined heat and power generation applications.	
Project Description: This project deploys a pre-commercial technology demonstrating a sorbent-based biogas purification process for combined heat and power generation at the pilot scale that removes multiple troublesome impurities from biogas, upgrading the fuel to near-pure methane for combustion in conventional prime movers. The pilot plant will be installed and tested at a brewery wastewater plant and at a landfill site to demonstrate the environmental and cost benefits of biogas purification prior to use in combined heat and power applications.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The project is advancing an innovative gas cleanup system based on temperature swing adsorption concept that adsorbs carbon dioxide and other contaminants while letting methane pass through and that regenerates the adsorbent bed leading to lower cost of operation. Converting biogas to high purity biomethane enables its use in premium efficient devices for power generation thereby helping reduce the cost of electricity. This technological approach will help meet renewable electricity goals at a lower cost and will enable use of marginal biogas sources for power generation applications using conventional natural-gas fired prime movers.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Self-Generation Incentive Program: R.12-11-005 SB 1122 Bioenergy feed-in tariff: R.11-05-005 Combined heat and power: D.10-12-035., R.08-06-024. [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1a, 1b, 3g, 4a, 4b
Lower Costs:
This project is expected to lower costs by reducing the number of stages required to condition biogas to meet fuel specifications of most prime movers.

Environmental Benefits:
The project will reduce carbon dioxide emissions by increasing the use of renewable fuel and replacing fossil-derived methane for electricity generation. The project will also result in fewer methane emissions by reducing the flaring of biogas into the atmosphere.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$105,570</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,318,940</td><td colspan="2">EPIC Funds Spent:
$352,393</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
InnoSepra, LLC: $930,000 (40.8 %)
ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.: $11,000 (0.5 %)
Waste Management of California, Inc.: $18,150 (0.8 %)</td><td colspan="2">Match Funding:
$959,150</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 27 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement</td></tr>
</table>

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Terms and Conditions. Pre-existing: U.S. Pat 8,591,627, 26 Nov 2013; U.S. Pat Appl 2014002675, 26 Sept 2013 Application number and date: Process for Upgrading Gases Containing Methane, to be filed in Feb 2015
Update: InnoSepra's gas conditioning system was upgraded and delivered to the Simi Valley landfill in September, 2018. After repairing some minor damage incurred during transport, the system has been functioning as designed, and the project team has focused on accumulating hours of operation. InnoSepra is currently negotiating with MillerCoors and a second company for a second demonstration using digester gas, but those negotiations are not yet complete.

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Project Name: The West Star North Dairy Biogas-to -Electricity Project [EPC-14-029]	
Recipient/Contractor: ABEC #2 LLC, dba West Star North Dairy Biogas	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/15/2015 to 3/29/2019
Program Area and Strategic Objective: Technology Demonstration and Deployment S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies	
Issue: Despite a regulatory environment encouraging renewable energy production and greenhouse gas reductions, dairy digester development has lagged in California. Fewer than twenty dairies in California have installed digesters and roughly half of these projects are operating. With dairy digesters having the potential to play an important role in providing renewable baseload electricity as well as reducing California's GHG emissions, California needs to demonstrate projects, which include design, operation and management strategies, that result in successful dairy digester-to-electricity projects.	
Project Description: This project advances digester design by building and demonstrating an innovative, double-cell covered lagoon digester and 1-megawatt (MW) generation system. The system will convert dairy manure into biogas and store the biogas above the primary and secondary lagoons under an inflatable cover. The biogas will be converted into renewable electricity and sold for export to the PG&E distribution grid. Further, dairy biogas systems qualify for participation in the CPUC's Assembly Bill (AB) 2514 electricity storage program. In a future phase, the biogas system may compete for an energy storage contract. The project will also improve groundwater protection by minimizing leaching of manure into the groundwater.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project demonstrates an improved digester design with the double cell lagoon for greater biogas storage and on-demand generation potential and, if successful, establishes dairies as competitors for storage contracts. The improved system will decrease dairy and digester operating costs while also enhancing the protection of groundwater. Other important benefits	

include: lowered manure handling costs and valuable co-products, such as nutrient rich, more absorbable irrigation water.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 3a, 4a, 4e

Lower Costs:

By advancing digester economics and design, through efficient manure management practices, the project will help lower dairy management and operation costs.

Environmental Benefits:

The project supports implementation of California's energy and GHG management goals and targets through the deployment of new renewable power generation capacity and the capture of methane currently vented into the atmosphere. The double-lined lagoon enhances groundwater protection by minimizing leaching of manure into groundwater. The project hired Climate Trust to estimate the Carbon Offsets that would likely be generated over the project's 10 year crediting period at 213,329 tonnes CO2e gross based on ARB's Livestock Protocol.

Consumer Appeal:

The project will improve odor control, through hydrogen sulfide removal, an issue important to the dairy employees and benefits the local community.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $32,107	
EPIC Funds Encumbered: $4,000,000		**EPIC Funds Spent:** $3,938,867	
Match Partner and Funding Split: ABEC #2 LLC, dba West Star North Dairy Biogas: $5,000,000 (55.6 %)		**Match Funding:** $5,000,000	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 23 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 2

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. Bioenergy Storage and Management System and Method. Lagoon Digester with Flexible Volume Capability. California Bioenergy LLC Lagoon Digester Systems.
Update: The project broke ground in fall 2016 and construction is complete. A TAC was held in October 2017, followed by a CPR in November 2017. The project accepted a 20-year PG&E BioMAT Power Purchase Agreement and is collecting data, including full operation commencing in the first quarter of 2018. Project is collecting operational data for a full year.

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Project Name:

Paths to Sustainable Distributed Generation Through 2050: Matching Local Waste Biomass Resources with Grid, Industrial, and Community Levels

[EPC-14-030]

Recipient/Contractor:

Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/15/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable

Issue:

There is a disconnect between studies that develop waste biomass utilization strategies and studies focused on identifying opportunities for distributed generation (DG), and specifically combined heat and power (CHP) or combined cooling, heat, and power (CCHP). No previous research has attempted to match local waste biomass sources in California with the variety of available conversion/power generation technologies and local demand for DG and waste heat applications to identify opportunities for efficient, cost-effective, and environmentally sustainable projects.

Project Description:

This project highlights locations where waste biomass can be used most efficiently and sustainably for distributed generation by developing scenarios through 2050 that identify the most promising opportunities for waste biomass DG, identifying key technical and regulatory hurdles to waste biomass DG utilization, developing tools for matching available waste biomass resources with energy production opportunities, and suggesting solutions for achieving cost parity with fossil fuels.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This analysis (1) identifies high-priority areas within California and feedstock types for further public deployment funding, (2) highlights promising geographic areas or available technologies to encourage increased investment in waste biomass DG by the private sector, and (3) improves efficiency and reduces environmental burdens by helping to minimize biomass transportation distances and maximize the efficiency of power production and waste heat utilization.

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CPUC Proceedings addressing issues related to this EPIC project:

Combined heat and power: D.10-12-035., R.08-06-024. [Closed]

Applicable Metrics: CPUC Metrics- 3c, 4a

Economic Development:

Integrated use of waste biomass (from municipal wastes, agricultural residues, and food processing wastes) for distributed generation applications in California has the potential to produce about 4.2 terawatt-hours of renewable electricity per year.

Environmental Benefits:

The use of waste biomass is expected to result in avoided fossil greenhouse gas emissions of about 2.5 million metric tons of carbon dioxide (CO2)-equivalent per year (of which 1.2 million tons is from avoided grid electricity, and 1.3 million tons is from avoided natural gas use for heating).

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $670,276	
EPIC Funds Encumbered: $1,500,000		**EPIC Funds Spent:** $1,500,000	
Match Partner and Funding Split: Energy Bioscience Institute: $50,000 (2.8 %) Allotrope Partners: $200,000 (11.2 %) PepsiCo R&D: $32,000 (1.8 %)		**Match Funding:** $282,000	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 25 out of 27 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

The researchers developed 2020 (near term) and 2050 (long term) scenario projections for waste biomass supply in California. Four TAC meetings were held to identify the scope and scale of waste heat and waste heat-generated cooling for customers in the domestic, commercial, and industrial process markets. The project has developed a county-level monthly wet and dry California biomass inventory, assessed the energy generation potential from food waste in California and identified counties where new anaerobic digestion capacity is needed. The researchers estimated energy demand density and identified areas with district heating/cooling potential by using building stock turnover model along with energy use intensity factors. The project developed a biositing tool, is matching biomass types and evaluating costs associated with relevant energy generation technologies.

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Project Name: Pollution Control and Power Generation for Low Quality Renewable Fuel Streams [EPC-14-031]	
Recipient/Contractor: The Regents of the University of California on behalf of the Irvine Campus	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/1/2015 to 3/31/2019
Program Area and Strategic Objective: Technology Demonstration and Deployment S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies	
Issue: Many potential renewable fuel streams cannot be used to generate electricity using current technology without considerable upgrading (i.e., increasing the heating value) and substantial clean up (e.g., cleaning contaminants such as hydrogen sulfide or siloxanes introduced by the feedstock). Prime examples include landfills that are approaching end of life that produce gases with some heating value, but the values are generally too low for commonly used combustion devices (e.g., reciprocating engines, gas turbines). Landfill biogases are also notoriously challenging due to the variability in level of contaminants.	
Project Description: The project proposed to use a 250 kW gas turbine system that converts relatively dirty, low heating value fuels into heat using gradual oxidation. This gradual oxidation technology was developed by Ener-Core, a California company, and has been demonstrated in operating systems for well over 500 hours, but has not yet been commercially deployed in California. The site for the demonstration was a closed landfill producing low quality gas that is currently flared. This site was a good match for the 250 kW demonstration as it eliminates the need for flaring of the otherwise unusable gas while generating electricity.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: If the project was successful, it would have demonstrated and deployed a novel gradual oxidation system in conjunction with a gas turbine that is capable of converting low-grade, and otherwise unusable, landfill biogas into renewable electricity.	

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CPUC Proceedings addressing issues related to this EPIC project:

Self-Generation Incentive Program: R.12-11-005 Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed]

Applicable Metrics: CPUC Metrics- 1a, 1c, 3a, 3h, 4a, 4b

Lower Costs:

If successful, this project would have generated 250 kW of baseload power, reducing peak demand to the surrounding grid and saving the landfill $240,000 annually.

Greater Reliability:

If successful, the electricity generated on site would have helped offset grid draw of power during peak use times, thus helping with overall reliability of the electricity system.

Environmental Benefits:

Low-grade biogas produced by landfills is typically flared. By utilizing it to produce electricity instead, this project would have reduced NOx produced at the landfill by nearly one ton annually.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$145,560
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,499,386	$1,020,425
Match Partner and Funding Split:	**Match Funding:**
Ener-Core, Inc.: $384,856 (19.9 %) ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.: $5,000 (0.3 %) Advanced Power and Energy Program (APEP) - University of California, Irvine: $48,489 (2.5 %)	$438,345
Leverage Contributors:	**Leveraged Funds:**
N/A	$0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	19 out of 23 bidders	Group 1: Ranked # 1

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Site engineering, drawings, and permitting requirements were completed in early 2016. An interconnection study with two supplemental reviews was completed by Southern California Edison in late 2016. The study identified the need for substation upgrades and an interconnection cost which far exceeded the budgeted amount. Consequently, the project sought a new landfill host site to demonstrate the novel gradual oxidation technology. A new site (with an existing interconnection agreement) was found and confirmed in mid-2017. However, the equipment installation continued to be delayed due to issues with a major subcontractor and the equipment developer for the project, Ener-Core. In December 2018, Energy Commission staff learned that due to funding issues, Ener-Core was not able to move forward with the project. A stop work order was issued in December 2018.

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Project Name:

Capturing Cultural Diversity in California Residential Energy Efficiency Potential: An Energy Ethnography of Hispanic Households

[EPC-14-032]

Recipient/Contractor:

Inova Energy Group, LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/8/2015 to 5/8/2018

Program Area and Strategic Objective:

Market Facilitation

S18: Guide EPIC Investments through Effective Market Assessment, Program Evaluation, and Stakeholder Outreach

Issue:

An increasing proportion of California's population identifies as being Hispanic, but Hispanics have historically had low participation in energy efficiency programs. Due to cultural background, frequent linguistic isolation, and higher densities of rental, low-income, and multifamily households, Hispanics are considered hard-to-reach customers in California's energy efficiency landscape and are found to have disproportionately low participation in energy efficiency programs. As such, there is a significant energy efficiency potential that has not been realized from this hard-to-reach group.

Project Description:

This project focused on reaching Hispanic subpopulations in California to better understand the social, cultural, and behavioral aspects of their decisions to adopt energy efficient technologies and behaviors. The study combined data collected from participants via energy usage journals, in-home interviews, and energy meters to further the knowledge of Hispanic cultural associations and beliefs related to energy use decisions and choices. The information gathered in this study can be used to improve the metrics and assumptions underlying energy demand forecasting and energy efficiency potential and goals studies. In addition, the study provided information that can be used for targeted marketing of energy efficiency programs to the Hispanic population and improved levels of service to these households.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase

customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of the Hispanic subpopulation that discourage or prevent their participation.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 5c

Greater Reliability:

New metrics on the impacts of utility energy efficiency programs for various subpopulations can increase the accuracy of energy demand forecasts used in Long Term Procurement Planning.

Consumer Appeal:

Energy efficiency programs that incorporate social, behavioral and cultural aspects into the program design are likely to have greater appeal to potential customers.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $10,681	
EPIC Funds Encumbered: $224,593		**EPIC Funds Spent:** $224,370	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 12 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 3

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project was completed in 2018. Key findings show that participants' energy-related behaviors were heavily influenced by family and community. For example, extended family members living under the same roof lead to variances in energy behaviors. Subtler implications include the use of energy to prioritize comfort for elderly family members. The study also found that participants did not tend to focus on the technical capabilities of energy-efficiency equipment or home envelope improvements, instead the focus was on behavior. For example, participants reported manually turning on and off their air conditioners rather than relying on the thermostat. The results of this project have been shared with IOU energy efficiency program managers and community based organizations to help increase Hispanic participation in energy efficiency programs.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: North Fork Community Power Forest Bioenergy Facility Demonstration [EPC-14-033]	
Recipient/Contractor: The Watershed Research and Training Center	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/15/2015 to 3/31/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies	
Issue: Forest biomass fueled bioenergy gasification projects have the potential to be more efficient and have cleaner electricity generation than direct combustion systems, and can reduce the risk of forest fires and pollutant emissions. The electricity generation is anticipated to be economical in the long-term, but is dependent on the ability of developers to achieve necessary operating hours. Due to lack of sufficient data and the absence of commercially operating forest gasification facility, there is a need to conduct gasification technology demonstration to collect additional scientific and technical data that will help demonstrate economic viability and attract private investment.	
Project Description: The North Fork Forest Bioenergy project is constructing and demonstrating a 1 megawatt (MW) forest waste bioenergy gasification-to-electricity facility in the foothills of the Sierra Mountains. The biomass gasification facility is targeted to be a commercial-scale, community-based facility capable of accepting and processing wood waste from forest management that would otherwise create wildfire and air quality challenges, and generating renewable grid-connected electricity. Once the gasification is fully installed and operational, the project will investigate critical performance parameters including best practices and evaluating individual components and protocols to improve performance and reduce operating costs.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This commercial-ready gasification technology has not been previously demonstrated in California. Combined with the producer gas cleanup system, automation and control, and optimized operation, this innovative system will prove distributed, woody biomass-fueled electricity to be economically feasible and capable of operating for 7,000 hours a year. The project will be grid-connected and will provide immediate benefits including increased	

renewable generation capacity, expanded technical resources, and community environmental, wildfire, and economic development benefits.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1c, 2a

Lower Costs:

Siting these plants near the forest reduces the cost of hauling biomass from the forest and reduces biomass electricity costs below those of larger, traditional biomass power plants.

Economic Development:

This plant will be built and operated by local contractors. In some cases, workers may even be trained to work on site. It is owned in part by a local Community Development Council, which will receive profits from the PPA and reinvest them in the community. Additionally, the power plant will anchor a biomass utilization campus, which will expand to include other forest products.

Environmental Benefits:

Use of forest restoration by-product will improve air quality over open burning and reduce wildfire threat or intensity. Removing small, overstocked trees from the forest will release water into the watershed. Additionally, the gasification system will reduce air pollutant emissions. Placer County Air Pollution Control District (PCAPCD) estimated emissions reductions of 60% CO2 and 3% CH4 in direct combustion systems with emission control over pile and burn system. Gasification could further reduce the emissions, e.g. from 85%to 99%reductions in NOx, 76%to 98% reduction in CO and 88% to 92% reduction in VOC compared to typical direct combustion based on some current gasification projects.

Public Health:

Disposing of biomass in controlled systems dramatically decreases emissions over pile and burn or wildfire, specifically the Particulate Matter (PM) emissions which has a known impacts on health. The same PCAPCD study estimated an emissions reduction of 41% particulate in combustion systems with emission control technologies over an open pile burning system. Gasification technology could further reduce the PM emissions by 84% to 99% compared to a typical direct combustion system depending on the technology.

Consumer Appeal:

Providing jobs, protecting homes, and enhancing functioning forest ecosystems through water release, increased biodiversity, and decreased wildfire threat are all benefits that this power plant will be able to advertise to increase consumer appeal.

APPENDIX B:
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<table>
<tr><td colspan="4">Energy Security:

This project will rely on California-grown fuel and operates as a baseload plant. Development will also require PG&E and plant owners to invest in the local substation. The availability of local bioenergy power plant that is connected to and supplying power to the grid will increase energy security for the rural community.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:

Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:

$87,680</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:

$4,965,420</td><td colspan="2">EPIC Funds Spent:

$3,225,772</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:

The Watershed Research and Training Center: $22,706 (0.4 %)
Phoenix Energy: $684,144 (10.8 %)
Yosemite Sequoia Resource Conservation and Development Council: $55,500 (0.9 %)
Western Energy Systems: $253,750 (4.0 %)
North Fork Community Development Council: $180,000 (2.8 %)
USDA Forest Service - Sierra National Forest: $150,000 (2.4 %)
TSS Consultants: $13,260 (0.2 %)
Kamalesh Doshi: $2,000 (0.0 %)</td><td colspan="2">Match Funding:

$1,361,360</td></tr>
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N/A</td><td colspan="2">Leveraged Funds:

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<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

19 out of 23 bidders</td><td>Rank of Selected Applicant/ Bidder:

Group 4: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

A Stop Work Order was put in place in September 2017 to halt expenditures while waiting for an executed power purchase agreement and for equipment to be delivered to the project site. The power purchase agreement with PG&E was approved in November 2017. As of December 2018, the project received approval to issue bonds for debt underwriting. Staff expects that financing will be finalized and construction/installation will resume in January 2019. The agreement term has been extended to March 2020.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstration of Integrated Photovoltaic Systems and Smart Inverter Functionality Utilizing Advanced Distribution Sensors

[EPC-14-035]

Recipient/Contractor:

Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable

Issue:

Power distribution networks of today have limited visibility and diagnostic capabilities and were designed to accommodate a limited number of rotating power generation plants. A future grid that incorporates large numbers of distributed PV systems will require different and more complex control mechanisms, which in turn will require coordinated control of both utility distribution equipment and solar inverters.

Project Description:

The research project is developing, demonstrating, and evaluating at the pilot scale the ability of an integrated, advanced PV and storage system at a state-of-art test bed in the LBNL Facility for Low Energy Experiments (FLEXLAB). The system includes smart inverter control to enhance and optimize grid support and system performance. The strategy evaluates the use of distribution synchrophasor unit data to support specific visualization and control applications on distribution circuits. The project includes a 13 to 15 kilowatt (kW) PV electric generating system and a 14 kW (56 kW-hour) battery storage installation at FLEXLAB.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will advance a breakthrough technology, a smart inverter with embedded synchrophasor, that is scalable across investor-owned utility territory leading to well coordinated and managed high-density PV installations and ratepayer benefits of greater reliability, lower costs, and increased safety.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

APPENDIX B:
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Applicable Metrics: CPUC Metrics- 1e, 2a, 3c, 3d, 3f, 4a, 5b

Lower Costs:

The installation includes 14 kW of PV and a 19 kWh battery that can provide 4.8 kW peak power for 4 hours (based on TOU high-peak pricing period). This will reduce energy costs to $139,500, and demand charges will be reduced to $53,000. The PV and battery combine for a maximum of 18.8 kW or 5% of peak demand.

Greater Reliability:

Ratepayers will see electricity reliability improve as high-density PV installations are coordinated and managed more efficiently.

Increase Safety:

This project will enhance grid safety by improving the ability for PV installations to detect and understand grid conditions and ensure safe operation in the event of grid failures.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $375,000
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $1,000,000
Match Partner and Funding Split: Tesla, Inc.: $25,000 (2.4 %)	**Match Funding:** $25,000
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 25 out of 27 bidders	**Rank of Selected Applicant/ Bidder:** Group 4: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The project built a central infrastructure and models for power systems study, mitigation strategies and control schemes with focus on California. All models and a library of recorded grid events are open-source and available to the research community. This project is pushing the state of the art by developing a new controller architecture based on model predictive control (MPC) methods to provide optimal control of the entire system of battery storage, PV system, and the building load, subject to a variety of power constraints, with the objective of minimizing the total energy cost for the customer. The controller was field tested and improved for a total of about 3 months. This project found that additional research is needed on the potential of dynamic change of smart inverter set points to better support the grid during critical situations.

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Project Name: Smart Inverter Interoperability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage [EPC-14-036]	
Recipient/Contractor: SunSpec Alliance	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/15/2015 to 3/29/2019
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable	
Issue: High PV penetration with legacy inverters on California grid feeder circuits can exacerbate problems associated with grid stability. While inverter power technology exists to address grid operating variability, a standard and cost-effective communication interface to monitor and control inverter operating functions has not been broadly deployed. It is currently both expensive and risky for grid operators to monitor and control diverse distributed energy resources (DER) assets. There is a need for a test framework for smart inverter interoperability, empirical data to validate the effects of smart inverters on the grid, and market data to evaluate economic impacts.	
Project Description: The project is developing a complete solution of smart solar PV-based DER system that addresses key barriers impeding the progress towards high penetration of solar and DER. The work includes development of a CA Rule 21 test framework and test scripts; compliance testing of smart inverters with functionality as described in the CPUC CA Rule 21 Smart Inverter Working Group (SIWG) recommendations; monitor and control inverter operating functions including participation in ancillary service for diverse DER assets; increase of photovoltaic (PV) penetration and cost effectiveness while enhancing safety and reliability of the California grid. This agreement will deliver a smart inverter test framework and open source software tools to enable rapid product development and safety testing and will demonstrate the benefits to all stakeholders including ratepayers, utilities, manufacturers, investors and operators.	

APPENDIX B:
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How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Smart inverters testing scripts for CA Rule 21 Phase 1 compliance were developed under this project. Testing proved that smart inverters made by different manufacturers perform CA Rule 21 Phase 1 autonomous functions in a manner consistent with the UL 1741 SA standard, thus increasing interoperability across PV system configurations and expanding customer choice. Project results proved that 100%+ renewables into the California grid is technically feasible, in combination with rapidly declining costs driven by global market efficiencies make state-level clean energy targets achievable and proved conclusively that smart inverters compliant with CA Rule 21 Phase 1 requirements can be installed safely at penetration levels of 100% or higher. Knowledge gained played a key role in the development of the Common Smart Inverter Profile that forms the basis of CA Rule 21 Phase 2 compliance.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Smart Inverter: D.14-12-035 (in R.11-09-011) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1b, 3d, 3f, 4a, 5b

Lower Costs:

A standard communication interface created by this project resulted in a reduction of approximately three- to six hours of labor per installation. Savings from standardization can provide $0.05 per installed watt savings in avoided switching costs. Plug and play capability means that the sensor components and software interfaces can be preserved. Savings in IOU cost avoidance for circuit upgrades is estimated at $0.16 to $0.30 per installed watt.

Greater Reliability:

A pilot installation of 17 solar plus storage solutions, networked according to CA Rule 21 Phase 2 and 3 requirements, provided operational data that enabled important insights into the DER commissioning and data networking processes, facilitating higher levels of renewable penetration and providing greater flexibility to local capacity with increased reliability through improved capacity optimization.

Environmental Benefits:

Enabling high penetration of solar PV and DER beyond the 15% IEEE limit resulted in reduced GHG emissions. Distributed resources similar to this project will also cost-effectively mitigate criteria pollutant emissions.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Grid Operations/Market Design	$162,005

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<table>
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$2,000,000</td><td colspan="2">EPIC Funds Spent:
$943,930</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
SunSpec Alliance: $1,421,875 (35.0 %)
Kitu Systems: $645,000 (15.9 %)</td><td colspan="2">Match Funding:
$2,066,875</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 27 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3; Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project developed open source test scripts for evaluating compliance to UL 1741 Supplement A. A total of five inverter brands were evaluated using SunSpec System Validation Platform (SunSpec SVP) and associated test scripts at the UC San Diego advanced function inverter test labs. Both lab and field testing proved that smart inverters respond in the same way as simulated when controlled through communication networks. Results showed that very high grid penetration levels by DER are technically feasible such that they far surpass the 15% limitation previously claimed to maintain grid balance and stability.</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Home Energy Efficiency Retrofits in California: An Analysis of Sociocultural Factors Influencing Customer Adoption

[EPC-14-037]

Recipient/Contractor:

Center for Sustainable Energy

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/8/2015 to 3/31/2018

Program Area and Strategic Objective:

Market Facilitation

S18: Guide EPIC Investments through Effective Market Assessment, Program Evaluation, and Stakeholder Outreach

Issue:

The current policy framework used to assess the adoption of residential energy efficiency measures is driven primarily by estimates of cost effectiveness. However, cost effectiveness calculations alone are inadequate to accurately predict adoption and market potential, as they do not capture the multitude of factors influencing the decision-making process of individual market sectors. Recent studies suggest that social, cultural and behavioral factors have a significant influence on the adoption of energy efficiency measures in residential households and should be considered in the decision-making process.

Project Description:

This project conducted a multidisciplinary, data driven study to understand the role and interactions of various factors influencing the adoption and utilization of residential energy efficiency measures. The study provided awareness into the stand alone and interactive effects of factors such as income, ethnicity, language, and political orientation on the adoption of energy efficient technologies, with a primary focus on the Latino population in the Fresno area. Knowledge gained from this study can be used to enhance energy policy and program design to account for social, cultural, and behavioral factors.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of the Hispanic subpopulation that discourage or prevent their participation.

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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 5c

Lower Costs:

Understanding social, cultural and behavioral aspects can help utilities more cost-effectively and efficiently market their energy efficiency programs to hard-to-reach customer groups.

Consumer Appeal:

Energy efficiency programs that incorporate social, behavioral and cultural aspects into the program design are likely to have greater appeal to potential customers.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $166,993
EPIC Funds Encumbered: $599,924	**EPIC Funds Spent:** $570,017
Match Partner and Funding Split: Renovate America: $214,000 (26.3 %)	**Match Funding:** $214,000
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 12 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

CSE's analysis of 704 records sample revealed that using brochures with imagery of modest houses and families that appeared Hispanic (as opposed to imagery of large homes and non-Hispanic, Caucasian families) had a positive impact on sign-up rates in census tracts with a high concentration of Hispanics. Despite this increased number of sign-ups, phone interviews with 30 self-identified Hispanic participants found few had completed or planned major upgrades based on the energy audit recommendations, though minor upgrades like weather-stripping or light bulb replacements were more common. These results highlight the importance of tailoring outreach materials for energy efficiency programs, and the efficiency potential that can be accessed through improved program outreach.

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Project Name:

Fieldwork to Document Technology Adoption and Behavior Change Across Diverse Geographies and Populations to Inform Energy Efficiency Program Design

[EPC-14-038]

Recipient/Contractor:

Indicia Consulting

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/8/2015 to 1/31/2019

Program Area and Strategic Objective:

Market Facilitation

S18: Guide EPIC Investments through Effective Market Assessment, Program Evaluation, and Stakeholder Outreach

Issue:

Technological innovation has been an impressive driver of efficiency gains; however, over time it has become clear that without a greater understanding of the human factors, potential energy savings will remain untapped. The goal of this research is to be able to recommend an alternative energy efficiency potential model. This new model would draw upon variables that are descriptive of culture and behavior among California sub-populations, and demonstrate the cost-effectiveness of programs designed to holistically address how different people experience and respond to technologies.

Project Description:

This project uses empirical research methods grounded in anthropology and other social and behavioral sciences to explore the factors affecting behavior beyond simple economic rationale. This practice is achieved by documenting and analyzing emerging attitudes, emotions, experience, habits, and practices around technology adoption for purposes of devising predictive indicators for on-going potential studies regarding energy consumption in California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of various subpopulations that discourage or prevent their participation.

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 5c

Lower Costs:

Understanding social, cultural and behavioral aspects of energy use and technology adoption can help utilities more cost-effectively and efficiently market their energy efficiency programs to hard-to-reach customer groups, resulting in greater participation and lower program implementation costs per kilowatt-hour saved.

Greater Reliability:

New metrics on the impacts of utility energy efficiency programs for various subpopulations can increase the accuracy of energy demand forecasts used in Long Term Procurement Planning and Resource Adequacy proceedings.

Consumer Appeal:

Energy efficiency programs that incorporate social, behavioral and cultural aspects into the program design are likely to have greater appeal to potential customers. The research includes recommendations on utility program design elements that are likely to appeal to the subset of customers who are more deeply engaged with their technological devices and who are more likely to use technology to manage and reduce their energy consumption.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $40,208	
EPIC Funds Encumbered: $574,545		**EPIC Funds Spent:** $459,714	
Match Partner and Funding Split: Indicia Consulting: $52,500 (8.4 %) California State University San Marcos		**Match Funding:** $52,500	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 12 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 5

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project is on schedule. All deliverables have been submitted. Reviewer comments have been provided on the draft Final Report. The Final Report will be published in January 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Self-Tracking Concentrator Photovoltaics for Distributed Generation [EPC-14-040]	
Recipient/Contractor: Glint Photonics, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/15/2015 to 3/31/2019
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable	
Issue: The highest efficiency PV cells are multijunction PV cells used in concentrator photovoltaic (CPV) systems, which offer about 40% conversion efficiency compared to about 16% for polycrystalline Silicon. However, concentrator photovoltaic systems require special mounting and precision tracking, and the resulting cost and complexity has prevented them from achieving significant market penetration.	
Project Description: This research develops, tests, and demonstrates a self-tracking concentrator photovoltaic (ST-CPV) system, a new concentrator photovoltaic technology that does not require a precision mechanical tracker to keep it aligned to the sun. The ST-CPV panel contains a thin layer of fluids that passively responds to the changing solar angle, automatically adjusting optical pathways within the device to ensure that incident sunlight is captured and concentrated over a wide range of angles. The passive internal tracking allows ST-CPV panels to be mounted in a stationary configuration or with a simple single axis tracker. This makes the system highly economical, greatly reduces installation and maintenance complexity, and enables distributed generation with higher efficiency CPV modules.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The project team estimates that 50% of rooftops would be appropriate for ST-CPV systems in California, where the average direct solar resource is 78% of the total solar resource. The successful development of this technology will bring significant manufacturing employment opportunities to California. Unlike conventional PV modules, ST-CPV modules are well-suited to local manufacturing because they do not benefit significantly from colocation with the	

semiconductor foundry. CPV cell technology is an area where US manufacturers have a substantial technical advantage over foreign competitors. An additional benefit conferred by this technology is an improved energy solution for remote off-grid communities. Many of such communities are located in desert areas of California that are particularly well-suited to the use of ST-CPV panels as a result of the high direct solar resource.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] California Solar Initiative: R.12-11-005

Applicable Metrics: CPUC Metrics- 1a, 4a

Lower Costs:

This research is developing a novel self-tracking concentrator panel that does not require a precision mechanical tracker to maintain alignment of the sun. This technology can cut the installed system cost for distributed PV systems in half. This novel self-tracking concentrator panel have the potential of producing a LCOE below 3.5 ¢/kWh for high direct normal irradiance (DNI) locations.

Economic Development:

The ST-CPV technology being developed under this project will help boost rooftop-installed solar energy that will produce renewable electricity, the equivalent worth of which will contribute to the state's economy. Additional benefits from successfully introducing ST-CPV products will accrue in job creation and improved peak demand management. Research indicates that the CPV market is interested in the coarse single-axis trackers, rather than on coarse two-axis trackers.

Environmental Benefits:

Greater adoption of PV power will reduce greenhouse gas emissions. Specifically, commercial adoption of ST-CPV systems on rooftops will help offset several millions of metric tons of carbon dioxide equivalent (CO2e) compared to conventional generation.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $282,545
EPIC Funds Encumbered: $999,940	**EPIC Funds Spent:** $863,465
Match Partner and Funding Split: United States Department of Energy: $1,000,000 (28.6 %) U.S. Department of Energy: $1,500,000 (42.9 %)	**Match Funding:** $2,500,000

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
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<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 27 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Glint Photonics fabricated and tested three different prototypes (GEN 1-3) on the stationary-mount module design, in which prototypes Gen 3 integrates improvements on optics and internal tracking mechanism from Gen 1 and Gen 2. The improved prototype has been characterized in laboratory and outdoor testing, and the team has also conducted panel washing experiments to quantify the effect of soiling on panel efficiency. The tracked data displays better performance after the washing experiment. Results have shown that the module power efficiency presents a peak over 22% and the PV cell efficiency is around 32%. The optical efficiency meets the > 55% target, with a peak of 70%, and the standard annual capture fraction is higher than 45 percent.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Installation of a Lean Burn Biogas Engine with Emissions Control to Comply with Rule 1110.2 at a Wastewater Treatment Plant in South Coast Air Quality Management District

[EPC-14-041]

Recipient/Contractor:

Biogas & Electric, LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2015 to 5/31/2018

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

Combustion of biogas in a low cost, lean burn combined heat and power (CHP) is vastly more economical than alternatives such as fuel cells, micro-turbines or conditioning biogas to pipeline quality. However, biogas fired internal combustion engines generate NOx and SOx, thus to obtain necessary air permits, biogas projects are required to deploy costly post-treatments such as selective catalytic reduction (SCR) to attain compliance. In addition to employing expensive catalysts, a downside of selective catalytic reduction -type systems is the need to maintain stocks of ammonia on hand to support the cleanup process.

Project Description:

This project aimed to design, build and install a continuously operating commercial scale emissions reduction system for the lean burn biogas engine(s) at a municipal wastewater treatment plant in Palm Springs California. If successful, the project would have enable lean burn biogas engines to comply with existing and future air quality regulations when deployed at wastewater treatment plants, resulting in reduced flaring and net reductions in emissions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The technology that was to be demonstrated was a low cost NOx and SOx reduction wet scrubbing technology called NOxRx (a registered trademark) which can be used in conjunction with all biogas engines and anaerobic digesters in the market today. NOxRx has a patented method of utilizing the effluent stream from an anaerobic digester to reduce emissions from biogas engines. Unlike SCR, it does not produce N2O and does not require H2S removal or biogas conditioning prior to combustion. Therefore, NOxRx represents a significant cost savings over competing NOx reduction solutions. The goal of this project was to demonstrate the commercial viability of NOxRx for biogas-fired lean burn engines to comply with CARB NOx and SOx standards, and SCAQMD Rule 1110.2.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1c, 1f, 3a, 3b, 4b, 4e

Lower Costs:

If successful, this project would have enabled operators to deploy low-cost internal combustion engines for biogas generation by avoiding the need for pre-treatment and by replacing conventional selective catalytic reduction with a wet scrubber that uses the chemistry of the plant's available effluent rather than purchased or stored chemicals.

Environmental Benefits:

Cost-effective solutions for converting biogas to power would have enabled wastewater treatment facilities to reduce flaring to the atmosphere, and subject the products of combustion to post-processing that will reduce NOx and SOx emissions to tighter regulatory standards.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $2,249,322	**EPIC Funds Spent:** $11,858
Match Partner and Funding Split: Anaergia Technologies, LLC: $450,000 (16.7 %)	**Match Funding:** $450,000
Leverage Contributors: N/A	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 23 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 5

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. Pre-existing: Patent number US 8, 012,746. Pending: 13/519,539 (7/27/12); US2010/61780 (12/22/10); 2,785,368 (12/22/10); 201080064956.8 (12/22/10); 10841589.4 (12/22/10); 5460/DELNP/2012 (12/22/10); 14/333,429 (7/16/14); US2014/046902 (7/16/14)
Update: Biogas and Electric was unable to demonstrate its emission reduction system at the Palm Springs and the project termed-out.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Enabling Anaerobic Digestion Deployment for Municipal Solid Waste-to-Energy

[EPC-14-044]

Recipient/Contractor:

Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/15/2015 to 3/30/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

Production of energy from waste biomass aligns with California's clean energy policies and diverts waste from landfills, reduces landfill methane and fossil carbon dioxide (CO2) emissions, reduces fossil fuel reliance, and improves grid reliability and resiliency. Using the organic fraction of California's municipal solid waste (MSW) for combined heat and power (CHP) generation would help the state meet its Renewable Portfolio Standard (RPS), diversify the mix of resources in the state's electric generation portfolio, and help municipal governments achieve sustainability goals.

Project Description:

The purpose of this project is to enable environmentally and economically sustainable deployment of technology that transforms organic municipal solid waste into heat, electricity, and compost via dry anaerobic digestion. A dry anaerobic digestion and composting facility processing the organic fraction of MSW has been scaled up from 40,000 tons/year to 90,000 tons/year to increase production of renewable electricity and heat.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project provides valuable insight to identify optimum pathways that overcome barriers for large-scale deployment of biomass conversion technologies. The research has focused on overcoming barriers for urban stakeholders, including odor, access to the utility grid, and improved utilization of waste heat.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Combined heat and power: D.10-12-035., R.08-06-024. [Closed]

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Applicable Metrics: CPUC Metrics- 2a, 3g, 4a

Lower Costs:

The renewable electricity and heat output has the potential to offset fossil fuel use, thus reducing fuel costs and helping to insulate ratepayers from future fluctuations in fossil fuel prices. It can produce up to 187.5 kwh electricity/tonne wet waste.

Economic Development:

It is estimated that 10 percent diversion of California's organic MSW for CHP generation has the potential to produce about 0.5 terawatt-hours (TWh) of renewable electricity per year, as well as about 51 million therms of renewable heat energy per year. Zero Waste Energy Development Company (ZWEDC) will receive $178,482 to $464,486 under the biomass feed-in-tariff price in annual revenue from electricity sales.

Environmental Benefits:

The strategies to minimize odor-causing and other air emissions will improve the potential for bioenergy facilities that can be sited in or near cities throughout California to reduce transportation costs. Avoided GHG is estimated to be 298,651 metric tons CO2e per year.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $1,497,504	
EPIC Funds Encumbered: $4,300,000		**EPIC Funds Spent:** $3,643,743	
Match Partner and Funding Split: Zero Waste Energy Development Company: $1,500,000 (25.9 %)		**Match Funding:** $1,500,000	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 23 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 6
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Researchers measured NOx emissions during several flaring events to establish primary NOx formation pathways, which may include thermal, fuel, and prompt NOx formation. The team performed air emission measurements and modeling to minimize odors and greenhouse gases from anaerobic digestion and the composting facility. Researchers have updated the Life Cycle Assessment model to identify opportunities for improved economic and environmental performance by quantifying the life-cycle cost, energy demand, and the GHG impacts of the existing ZWEDC facility and paths to scale-up. ZWEDC has interconnected to PG&E grid and enrolled in CAISO to enable sale of net electricity.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Advanced Recycling to 1-MW Municipal Solid Waste of Electricity Generation

[EPC-14-045]

Recipient/Contractor:

Taylor Energy

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable

Issue:

In California, 30-million tons of organic materials are added to landfills each year. There is a broad gap in available technology and scientific knowledge required for economic use of municipal solid waste as a gasification feed, particularly in the 1-MWe to 20-MWe power output range. There is a market need to address refuse derived biomass as an opportunity feedstock and to address the equipment size range needed for distributed power generation in California communities.

Project Description:

This project designs, develops and tests a waste-to-energy Process Development Unit (PDU), involving conversion of Refuse Derived Biomass into clean fuel gas by Thermal-Catalytic Gasification, Reforming and Pulse Detonation Technology. This is a two-stage process, with a primary gasification stage, followed by a reforming stage; and hot filtration, followed by wet scrubbing of the process gas. This project tests a 3-pound per minute PDU, evaluates the results, and provides engineering data to design a 30 ton/day plant generating 1-MW electric power.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project researches, develops, and verifies thermal catalytic gasification technology that will overcome technical and economic barriers preventing the use of refuse derived biomass (RDB) as an energy resource in California. Completion of the current gasification/reforming test program enables future scale-up to 30-ton/day RDB-to-energy (1-MWe scale), in preparation for commercial scale design at 300-ton/day, generating 10-MW of electricity with costs of less than $3,750/kWh of installed capacity.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Combined heat and power: D.10-12-035., R.08-06-024. [Closed]

Applicable Metrics: CPUC Metrics- 2a, 4a, 4e

Lower Costs:

The Levelized Cost of Electricity is estimated at $118/MWh for 10-MW scale, which results in ratepayer savings of approximately $30/MWh compared to grid supplier power that will likely average $150/MWh through 2024.

Environmental Benefits:

The project will divert MSW from landfills and generate electricity, reducing NOx emissions from flaring or direct combustion by approximately 6.5 TCO2e/year.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $188,248	
EPIC Funds Encumbered: $1,499,481		**EPIC Funds Spent:** $1,340,735	
Match Partner and Funding Split: Taylor Energy: $46,616 (3.0 %)		**Match Funding:** $46,616	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 25 out of 27 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Patent. Gasifying Carbon Materials: Jet Spouted Bed Integrated with Draft-Tube Reformer, both powered by pulse-detonation -burner(s) and bed material optimum for the process.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

Design and fabrication of the Process Development Unit and equipment layout work at the host site is complete. Major equipment, consisting of PDU, Reformer, gas-flare and gas conditioning equipment was installed. Testing of the gasification system has started. One TAC meeting and two CPR meetings were held to review project progress towards achieving goals and objectives. Initial startup of the gasification was performed using 8 lbs. of wood pellets, and then refuse derived biomass. The pulse burner operated at 900 degrees C and produced 9.47% char by weight. Startup testing is complete. The rate of char conversion was increased by a modification to the gasifier that allows char particles to stay longer in the gasification zone. This modification also resulted in increased syngas production.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Lowering Food-Waste Co-Digestion Costs through an Innovative Combination of a Pre-Sorting Technique and a Strategy for Cake Solids Reduction

[EPC-14-046]

Recipient/Contractor:

Kennedy/Jenks Consultants, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

Energy generation potential through the digestion of municipal sewage at wastewater treatment plants (WWTP) and the co-digestion of fats, oils and grease (FOG) and food wastes is estimated at more than 600 megawatts (MW). While combined heat and power generation systems using digester gas are highly beneficial, several barriers exist that impede the installation of these systems. Among the key barriers for food waste co-digestion are the challenges in pre-processing food wastes prior to their addition to the digesters.

Project Description:

The project demonstrates two complementary approaches to lower the overall cost of co-digestion: a new technology to lower preprocessing cost of food wastes, and a new strategy to lower the mass of cake solids requiring disposal. The new technology for the preprocessing of food wastes uses an organic waste preprocessing technique known as an organic extrusion press (OEP) for selective extrusion of organic materials and is capable of recovering 95% of organics. The project applies a new strategy in operating co-digestion systems that involves optimizing the organic waste loading in a way that will lower the mass of cake solids requiring disposal relative to the conventional process.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will result in reliable and cost-effective bioenergy from wastewater treatment plants (WWTP) through the integration of an organic waste preprocessing technique known as organic extrusion press and co-digestion of locally available food waste and restaurant fats, oil, and grease (FOG) in an optimized manner that lowers the mass of cake solids that

needs disposal. Though there is some seasonal variation, the supply of wastewater, food waste and FOG are very reliable.

CPUC Proceedings addressing issues related to this EPIC project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 3a, 4a, 4e

Greater Reliability:

Applying the results of this project to waste water treatment facilities will reduce grid imports and provide a reliable generation source for these facilities and the grid. With the technology advancement supported by this project, the estimated increase in annual energy production at the demonstration facility is approximately 7,400 MWh.

Environmental Benefits:

The technology from this project has the potential to reduce greenhouse gas emissions by 443,345 MTCO2e/year at a modest 10% market penetration. Furthermore, a lower volume of sludge requiring disposal will lower the emissions from trucks used for hauling sludge.

Public Health:

The project will help avoid manual handling and separation of decomposable waste materials and divert up to around 4,100 tons per day of food wastes out of landfills. Manual separation of food waste risks staff exposure to unsanitary conditions and potential inhalation of pollutants from purifying organic materials, resulting in sickness and other adverse health effects.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $323,906
EPIC Funds Encumbered: $1,496,902	**EPIC Funds Spent:** $592,872
Match Partner and Funding Split: Silicon Valley Clean Water (SVCW): $2,600,000 (63.0 %) Water Environment & Reuse Foundation: $30,000 (0.7 %)	**Match Funding:** $2,630,000

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 23 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The research team completed benchmarking of digester performance for operations without the addition of food waste and Fats, Oils and Grease (FOG) at two sludge loading conditions. Digester tests were completed through addition of FOG to the digesters at three loading conditions. To facilitate the FOG testing, a FOG preprocessing unit was installed and operated. Installation of the Organics Extrusion Press (OREX) for extraction of food waste is completed, along with the initial characterization of the extruded food waste. A food waste receiving station and a polishing unit for OREX extracted food waste is installed and trial tested. Tests using polished food wastes are expected be completed in January 2019. Results from the study were presented at WEF Residuals & Biosolids Conference in April 2017 and CWEA annual conference in April 2018.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Dairy Waste-to-Bioenergy via the Integration of Concentrating Solar Power and a High Temperature Conversion Process

[EPC-14-047]

Recipient/Contractor:

Southern California Gas Company

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/15/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable

Issue:

Because of the intermittent nature of many renewable energy sources, special attention must be taken when connecting them to the electrical grid. Energy storage technologies have the potential to increase the reliability of California's energy supply, as well as the ability to dispatch renewable energy sources on demand instead of upon production. Yet, traditional forms of energy storage are often prohibitively costly and lack mature mechanisms for participation in electricity markets.

Project Description:

The goal of the project is to integrate Concentrating Solar Power (CSP) and Hydrothermal Processing (HTP) into a single, integrated system; confirm that it can convert dairy manure into RNG and bio-crude; study the economics of integrated CSP-HTP systems sited at dairy farms; and confirm that the RNG produced meets pipeline-transmission and geological-storage quality standards. In this way, the project anticipates proving that it is possible to store the energy contained in dairy manure waste in a manner that enables California natural gas plants to produce readily dispatchable, ultra-low-emissions renewable electricity.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will develop and demonstrate a new bioenergy pathway which utilizes hydrothermal processing and concentrating solar power to convert dairy manure into bio-crude and renewable natural gas that will enable dispatchable and low emissions renewable electricity.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Energy storage: R.15-03-011 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1i, 2a, 3g, 4a, 4b, 4e

Lower Costs:

Cost-effective production of pipeline-quality renewable natural gas and bio-crude will offset use of fossil fuels and provide a pathway for low-cost energy storage, reducing peak electricity costs and lowering the price for ratepayers. The project team estimates a renewable electricity production cost of approximately $69 per MWh ($0.069 per kWh), much cheaper than comparable renewable resources.

Economic Development:

Commercialization of this technology would positively impact several markets including: dairies, fuel refineries, natural gas pipeline operators, and electricity producers. In addition, the project itself employs approximately 9 individuals in San Diego and Imperial County.

Environmental Benefits:

By converting dairy manure into renewable natural gas and bio-crude, greenhouse gas emissions typically associated with manure can be avoided. The project teams estimates that a commercial-scale facility using this technology would result in annual net greenhouse gas emission reductions of approximately 3,440 metric tons of carbon dioxide equivalent per year.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $98,501	
EPIC Funds Encumbered: $1,494,736		**EPIC Funds Spent:** $851,946	
Match Partner and Funding Split: Southern California Gas Company (SoCalGas): $600,000 (28.6 %)		**Match Funding:** $600,000	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 25 out of 27 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Redesign of the CSP receiver was completed by NREL in early 2016, and fabrication of the receiver was completed in 2017. Design of the Genifuel hydrothermal processing (HTP) unit with input from the Pacific Northwest National Laboratories (PNNL) was completed in late 2016 and a fabricator was chosen in early 2017. Construction of the HTP system is complete and the Hyperlight CSP facility has been expanded to a half acre in size using redesigned collectors and receivers. The HTP system has been commissioned and testing is taking place after integration with the Hyperlight system.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

City of Fremont Fire Stations Microgrid Project

[EPC-14-050]

Recipient/Contractor:

Gridscape Solutions

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/8/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

California needs to make better use of locally available renewable energy to increase resiliency and address climate change impacts, such as increased fires, severe storms, and heatwaves. Critical facilities are especially vulnerable to climate change impacts that disrupt the normal delivery of energy needed for their operation. Microgrids can help increase the resiliency of critical facilities such as fire stations through maximizing use of local renewable energy with energy storage.

Project Description:

The project team designed and built microgrids at three fire stations in Fremont, California. Each microgrid consists of a microgrid energy management system, a parking lot canopy photovoltaic system, and a battery energy storage system. The automated microgrid control system manages local energy resources and loads. The microgrids are designed to provide at least three hours a day of power for critical loads during a utility power outage.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Critical facilities, such as fire stations, are vulnerable to power outages, so having local, renewable generation decreases their dependence on outside electricity sources. This is the first implementation of microgrids for several fire stations in the region and creates a great opportunity for proof of concept to overcome risk and knowledge barriers to adopting high penetration solar PV systems and energy storage, demonstrate energy efficiency by optimizing power generation and loads, and provide increased energy security during utility power outages. The microgrids will help reduce grid congestion and increase grid reliability.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a

Greater Reliability:

This project will reduce grid congestion and improve resiliency for the distribution system by combing local photovoltaic generation and energy storage, thus reducing the utility load where substations are near maximum capacity. The fire stations will be able to operate at least three hours a day during a utility outage.

Environmental Benefits:

This project will reduce carbon dioxide emissions by using local clean power generation (solar photovoltaics) and energy storage when available. This emissions reduction will help the City of Fremont meet its greenhouse gas emission target and achieve its zero net energy goals for city government buildings.

Energy Security:

The fire station microgrids will provide at least three hours a day of electricity to critical loads during utility power outages. The fire stations are vulnerable to earthquakes from the nearby Hayward faults, so having local, renewable generation decreases their dependence on outside electricity sources.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $73,475
EPIC Funds Encumbered: $1,817,925	**EPIC Funds Spent:** $1,645,995
Match Partner and Funding Split: Delta Products Corporation: $71,691 (2.9 %) City of Fremont: $80,000 (3.2 %) Microgrid Energy: $10,000 (0.4 %) Gridscape Solutions, Inc.: $495,569 (20.0 %)	**Match Funding:** $657,260
Leverage Contributors: N/A	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	31 out of 40 bidders	Group 1: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Gridscape Solutions has successfully completed design, procurement, construction, and commissioning of the microgrids at all three fire stations. The microgrid at Fire Station #11 has been operational since September 2017, while the other two microgrids have been operational since October 2018. The second two microgrids were held up by delays in addressing liquefaction issues at the sites and obtaining interconnection agreements. Data collection for all three microgrids is in progress. Gridscape has also presented this project at several conferences such as Silicon Valley Energy Summit and VERGE Microgrid Summit. It is expected to commercialize this technology by the end of the agreement in early 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy

[EPC-14-051]

Recipient/Contractor:

All Power Labs, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/15/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable

Issue:

California has an opportunity to help achieve the state's renewable energy goals using biomass from forest management, but it also faces conflicting challenges managing parched forests in a time of drought and climate change. Gasification is a key technology to forest biomass-to-energy conversion leading to reliable energy, reduced cost and greenhouse gas (GHG) emissions, and reduced risk of forest fires. Current related technologies are not profitable at distributed scales. Further, any negative environmental impacts from the use of forest waste and biomass resources in the state must be mitigated with appropriate technology and management strategy.

Project Description:

This project aims to design, deploy, and test a 150 kilowatt-electric (kWe) modular, mobile biomass gasification generator (the Powertainer) that converts forest slash biomass into on demand renewable energy and meets the California Air Emission Standards. The results of the demonstration will be analyzed to determine (1) optimal siting to enhance grid stability, (2) impact of monetizing current forest waste as fuel on ability to increase forest thinning and lower wildfire risk, and (3) impact of increased thinning on availability of hydrological resources.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project develops and demonstrates a higher capacity, mobile conversion system capable of cost-effectively converting forest biomass near where it is sourced into renewable, on-demand energy to help address a myriad of issues associated with climate change, including drought, fires, and the need for more renewable energy.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1c, 4a

Lower Costs:

The project uses increased forest thinning to produce renewable energy more economically via a low cost modular and mobile biomass gasification technology that is able to have a levelized cost of energy at or below SB1122 incentive target levels. It is estimated that the 150 kW Powertainer has an energy cost reduction of $97,761, assuming 788,400 kWh sold at $124/MWh, as SB1122 1014 Renewable Market Adjusting Tariff (ReMAT) price.

Greater Reliability:

The Powertainer has the potential to offer flexibility in meeting location-specific needs while supporting critical operations and assisting fire events, such as to provide electricity as a measure of self-reliance to a nonexistent or severely damaged grid. For a 150 KW Powertainer unit running one full year at a 60% capacity factor, it is estimated a potential of annual electricity saving of 788,400 kWh and peak load reduction of 150 kW.

Environmental Benefits:

The project reduces about 95%+ in Carbon Monoxide, Volatile Organic Compounds, and PM-10 emissions compared to burning forest wastes. The 150 kW Powertainer is expected to replace 788,400kWh of grid electricity on an annual basis. Assuming 281.8 g CO2e/kWh, this technology would save 222,171 kg of Carbon Emission/year, and reduce 68,780 gallons of water from energy saving.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $311,727
EPIC Funds Encumbered: $1,890,125	**EPIC Funds Spent:** $1,563,059
Match Partner and Funding Split: All Power Labs, Inc.: $686,038 (26.6 %)	**Match Funding:** $686,038
Leverage Contributors: N/A	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	25 out of 27 bidders	Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team concluded activities related to the Engineering Validation Testing (EVT) and Design Validation Testing (DVT) to prepare the system to perform a 40-hour engine test on fully assembled system. In the EVT, the project team tested the minimum uptime capacity to determine whether or not the gasifier meets the desired minimum uptime capacity for the Powertainer. The target was to power the generator set at 75kW for 8 hours continuously and the gasifier was able to demonstrate its ability to support operations for extended run time. The team also conducted a test to determine the amount of tar present in the producer gas. The tar content of the gas post-gasifier and post-filter shall not exceed 1500 mg/m3 and 1000 mg/m3, respectively. Although the criteria were met, numbers might improve once the reactor is at the correct operating temperature with a proper load on the system.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Community Scale Digester with Advanced Interconnection to the Electrical Grid

[EPC-14-052]

Recipient/Contractor:

Organic Energy Solutions, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

Digester systems have the potential to play an important role in providing renewable electricity while reducing California's GHG emissions. Despite a regulatory environment encouraging renewable energy production and greenhouse gas reductions, there is a need for technology to lower the system cost as traditional methods require high capital costs to remove organic materials from the wastewater stream to create good quality slurry for an anaerobic digester system.

Project Description:

The project's aim is to install and operate an innovative anaerobic digestion system using a high-rate biodigester technology that will process approximately 50 tons per day (TPD) of organic waste from a large supermarket (Albertsons) distribution center and 50 TPD (20,000 gallons) of high-strength slurry created by recovering and concentrating organics in wastewater streams. This project is co-located with the Co-West Commodities Wastewater Pre-Treatment Facility- an operation that collects wastewater (carbs, sugar, protein, and fat, grease, and oil known as FOG) from industrial businesses and pre-treats the material for disposal into the local sewer system.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will demonstrate the use of electrical generation powered by digester gas to provide reliable power to a critical facility during outages on the grid. The electricity from this project will be exported to the SoCal Edison distribution grid through SB 1122 Bioenergy Feed-in Tariff. The system will also be equipped with islanding capability to support the critical facility during an interruption in the grid.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1b, 1c, 2a

Lower Costs:

The method developed by this project would lower the system cost, resulting in a significantly lower price of electricity compared to traditional or fossil generation. The estimated LCOE is $122/MWh.

Greater Reliability:

This project will provide reliable renewable electricity without the need for standby and backup power, capable of providing power during peak energy demand.

Economic Development:

The coproducts are 1,226 tons of residual solids for vermicomposting feedstock per year; and, 1.6M gallons per year of liquid effluent for fertilizer.

Environmental Benefits:

The project will divert and use food wastes to generate electricity that will yield reductions in GHG emissions. The net CHG offset is 4,125 MT CO2e/year. It will also improve environmental quality by providing clean energy while improving wastewater quality and reducing odor via anaerobic digestion.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $252,977
EPIC Funds Encumbered: $5,000,000	**EPIC Funds Spent:** $3,459,038
Match Partner and Funding Split: Organic Energy Solutions: $7,700,539 (60.3 %) CleanWorld: $75,400 (0.6 %)	**Match Funding:** $7,772,939
Leverage Contributors:	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	19 out of 23 bidders	Group 3: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team has completed the design phase and purchased equipment for the demonstration which is currently being stored off-site. However, because the project experienced delays in interconnection and permitting processes, the grantee will not be able to complete the installation and testing within the term of the agreement. A stop work order was issued in December 2018 pending Energy Commission determination as to how to proceed.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

A Renewable Based Direct Current Building Scale Microgrid

[EPC-14-053]

Recipient/Contractor:

Robert Bosch LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

Microgrids can enable a building owner to lower operating costs and to operate in a grid outage. Microgrids developed to date rely on converting direct current (DC) from renewable generation to alternating current (AC) to support building loads. However, DC to AC conversion results in energy losses. A potential solution to further increase the benefits of microgrids is to develop a DC-based building with DC loads (e.g., lighting, fans). DC buildings are a research area that has not been evaluated fully by extensive research before, and require proof of concept to gain traction in the market.

Project Description:

The team developed a DC microgrid that connects on-site generation directly with loads and provides a low cost, energy-efficient solution for warehouse facilities. Solar PV is directly connected to energy-efficient DC lighting, a DC energy storage system, and ventilation to form a DC building microgrid. This microgrid system reduces the need for inverters for PV and rectification equipment for the loads and is operated by a Bosch microgrid controller system. The microgrid improves the overall utilization of solar energy by roughly 7-10% as compared to conventional AC systems, while lowering component complexity and costs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will demonstrate the feasibility and benefits of a commercial-scale DC building microgrid that uses multiple DC technologies to provide reliable power to the loads on DC circuits, resilience during grid outages, increased energy efficiency and renewable energy utilization with lower losses.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs:

By operating advanced technologies such as LED lighting and energy storage systems on DC power as opposed to AC power, installation and operating costs will be reduced, improving the economics for microgrid deployment.

Greater Reliability:

Bosch has validated that this microgrid supports all the critical loads during a grid outage for smooth operations (e.g., warehouse lighting, ventilation, fork-lift charging), and eliminates the requirement to run the diesel generator.

Environmental Benefits:

If adopted by 2-5 percent of commercial buildings in California, a DC microgrid can result in 128 gigawatt-hours per year of energy savings. This translates to avoided carbon dioxide emissions of 36,000 metric tons per year, and avoided NOx emissions of 343 metric tons per year.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $276,825
EPIC Funds Encumbered: $2,817,566	**EPIC Funds Spent:** $1,917,138
Match Partner and Funding Split: Regents of the University of California, Davis - California Lighting Technology Center: $9,183 (0.2 %) Maxwell Technologies: $56,393 (1.2 %) Imergy Power Systems: $45,000 (1.0 %) AMERICAN HONDA MOTOR COMPANY, INC.: $110,631 (2.4 %) Robert Bosch LLC: $1,576,337 (34.2 %)	**Match Funding:** $1,797,544
Leverage Contributors:	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	31 out of 40 bidders	Group 2: Ranked # 1
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: No outstanding issue other than Bosch getting out of microgrid business. CAM working on final report with PI.			

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstrating a renewable based microgrid for a critical facility at the Blue Lake Rancheria [EPC-14-054]

Recipient/Contractor:

Humboldt State University Sponsored Programs Foundation

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	7/6/2015 to 3/30/2018

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

California needs to make better use of locally available renewable energy to increase resiliency and address climate change impacts, such as increased fires, severe storms, and heatwaves. Microgrid demonstrations are needed to show that renewable based microgrids at critical facilities are able to disconnect from the grid and provide islands of stable, independent power using local renewable energy to maintain critical operations during emergencies.

Project Description:

This project team developed and demonstrated a microgrid at an American Red Cross evacuation center. The microgrid included renewables and energy storage to bolster the resiliency of this critical support facility and the capability of the microgrid to power itself with a high penetration of local renewable resources.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project advanced microgrid technology by demonstrating a new microgrid controller and integrating a set of equipment that had not previously been combined in a microgrid setting. The project demonstrated the ability to integrate solar electric power with battery energy storage, conventional generators, and dispatchable demand into a microgrid to support a certified American Red Cross shelter, with an added benefit of relegating the existing fossil fueled generators to a deep backup role where they rarely run. A microgrid control system was successfully implemented using protection relays to provide safe and reliable microgrid operation. It was able to perform automated transitions from grid connected to islanded states in response to the state of the area electric power system.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs:

The solar PV array and battery storage system will lower annual energy purchases and also lower average peak demand by using onsite renewable energy resources resulting in a cost savings of approximately $160,000 per year.

Greater Reliability:

The microgrid is capable of supplying electric power indefinitely, even in the event of a utility grid outage increasing the resiliency of the Rancheria. The microgrid controller prevents uncontrolled export of energy to increase grid reliability by preventing reverse power flow onto the grid.

Increase Safety:

The microgrid increased the safety of the community by being able to provide electric power to a critical Red Cross emergency response center when the electric grid goes down during a disaster.

Environmental Benefits:

The microgrid reduces power purchased from the electric grid by using onsite renewables and reduced greenhouse gas emissions by 158 metric tons CO2 per year compared to fossil fueled generation.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Distribution	$832,908
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$5,000,000	$5,000,000
Match Partner and Funding Split:	**Match Funding:**
Serraga Energy, LLC at Blue Lake Rancheria: $715,935 (11.3 %) Humboldt State University Foundation, Schatz Energy Research Center: $82,221 (1.3 %) GHD, Inc.: $10,266 (0.2 %)	$1,318,422

<table>
<tr><td colspan="2">Siemens Energy and Automation, Inc.: $250,000 (4.0 %)
Tesla, Inc.: $210,000 (3.3 %)
Pacific Gas and Electric Company: $50,000 (0.8 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 40 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project was completed in March 2018. The Blue Lake Rancheria renewable microgrid has demonstrated a robust, renewable-based microgrid system that provides costs savings for the facility during normal operation and successfully islanded during a grid outage. As a result of knowledge transfer and outreach activities, the microgrid project received the Federal Emergency Management Agency's 2017 Whole Community Preparedness Award and POWERGRID International's Project of the Year (2018) award for Distributed Energy Resource Integration, marking the first time that a non-utility won the award. The final report is available at: https://www.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf.</td></tr>
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APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Las Positas Community College Microgrid

[EPC-14-055]

Recipient/Contractor:

Chabot-Las Positas Community College District

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/8/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

California needs to make better use of locally available renewable energy to increase resiliency and address climate change impacts, such as increased fires, severe storms, and heatwaves. Microgrids are able to disconnect from the grid and provide islands of stable, independent power that maximizes the use of local renewable energy. Microgrids can reliably integrate energy efficient demand-side resources, distributed clean energy generation, and smart grid components to enable energy smart community development, which is critical for academic campuses.

Project Description:

This project is demonstrating the ability of a commercial-scale microgrid to optimize distributed energy resources for a campus, and distribution utilities by using advanced energy management tools to coordinate a high penetration of renewable energy assets with energy storage technologies on a community college microgrid.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project identifies and measures the benefits of microgrids for customers that shift peak energy use to coincide with peak solar production and for distribution utilities by demonstrating the resource capability of microgrids. This project will measure the microgrid's benefits by using existing retail rates as well as simulating a market in which all microgrid benefits can be monetized.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs:

The project will try to optimize renewable energy production and energy utilization to reduce maximum demand, peak demand, and part-peak demand with a goal of 400kW reduction. Based on the campus' current tariff, this could reduce annual demand charges by approximately $60,000.

Greater Reliability:

The project may increase energy reliability on the campus by increasing the amount of solar energy that is used for campus operations instead of allowing uncontrolled export of solar energy to the local utility grid. Controlling the export of energy onto the grid will also increase reliability by reducing congestion.

Energy Security:

The project will attempt to increase energy security of the campus by enabling critical loads on the campus to island from the main distribution grid and operate for up to 10 hours with power generated from the campus solar PV system.

Assignment to Value Chain: Distribution		**Total Budgeted Project Admin and Overhead Costs:** $260,719	
EPIC Funds Encumbered: $1,522,591		**EPIC Funds Spent:** $883,725	
Match Partner and Funding Split: Chabot-Las Positas Community College District: $450,000 (22.8 %)		**Match Funding:** $450,000	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 31 out of 40 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 3

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project team completed installation of the system and commissioning of the microgrid and has begun measurement and verification of the energy efficiency elements of the project. An additional master control system was installed to coordinate the demand charge management software and the islanding transfers. PG&E approved the system to operate. The team presented at the February 2018 California K-12 Facilities conference and the April 2018 PG&E Microgrid Workshop for Campus Facility Directors.

Project Name: Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid [EPC-14-056]	
Recipient/Contractor: The Regents of the University of California, on behalf of the Los Angeles Campus	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/30/2015 to 3/30/2018
Program Area and Strategic Objective: Technology Demonstration and Deployment S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development	
Issue: Plug-in electric vehicles (PEV) offer a promising alternative to meet the state's transportation needs. However, the increase of PEVs in California presents both a challenge and opportunity for the grid. Specifically, charging large numbers of PEVs can result in load spikes, if the charging is not coordinated and controlled. However, PEVs can potentially be a resource to the grid when plugged in, providing power when needed by the grid. Research is needed to determine the best approaches to managing a group of PEVs, such as in a parking garage.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Description:

This project installed PEV charging equipment in five sites in Santa Monica to demonstrate scenarios that represented new power needs, including smart charging, peak shaving, load management, and load smoothing while improving power quality and grid stability. The selected sites reflected a variety of scenarios including public charging, fleet charging, integration of solar generation with charging, and integration of energy storage with fast charging. Further, the project assessed the usefulness of vehicle to grid and vehicle to building technologies for allowing bi-directional energy flow and using PEVs as distributed energy storage. The project objective was to provide a model (using simulations to predict grid behavior and emulations using real-world power flows) that could be used by fleet owners or building owners for grid planning, pricing, and incentive decisions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Most current electric vehicle service equipment (EVSE) provide uncontrolled charging without using smart algorithms, software, or standard network technologies. This project demonstrated a pre-commercial PEV infrastructure that used a control center, communicating over a wireless communication network, to control the charging operations of the EVSEs using smart charging algorithms. The pre-commercial infrastructure (WINSmartEV TM) developed by UCLA was advanced so that it is able to determine optimized charging and/or vehicle to grid services based on PEV profiles, user preferences, grid-related events, and grid capacities.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1h, 3f, 4b

Lower Costs:

Smart charging of vehicles showed that PEVs can participate in demand charge reduction and demand response to enable a site owner or fleet manager to avoid demand charges and take advantage of time-of-use pricing. This saves money for the site owner and improves the economics for fleet owners to convert to PEVs.

Greater Reliability:

Application of the smart charging algorithms can potentially increase grid reliability by using the PEVs as the equivalent of energy storage. This was compared with the grid impacts of the surrounding area to determine the effectiveness of this approach.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$358,770

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

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<tr><td colspan="2">EPIC Funds Encumbered:
$1,989,432</td><td colspan="2">EPIC Funds Spent:
$1,657,751</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
California Lithium Battery: $100,000 (4.0 %)
Proximetry: $130,000 (5.2 %)
City of Santa Monica: $146,000 (5.9 %)
Korea Institute of Energy Research (KIER): $36,000 (1.4 %)
The Regents of the University of California, Los Angeles: $88,000 (3.5 %)</td><td colspan="2">Match Funding:
$500,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
City of Santa Monica: $146,000
Korea Institute of Energy Research (KIER): $36,000
UCLA MAE: $218,000
California Lithium Battery: $100,000</td><td colspan="2">Leveraged Funds:
$500,000</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 40 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The final report was published in August 2018: http://www.energy.ca.gov/2018publications/CEC-500-2018-020/CEC-500-2018-020.pdf. The research demonstrated that large numbers of PEVs can be managed for the benefit of the PEV and facility owners. The recipient successfully developed a system, utilizing existing charging infrastructure and without adding large amounts of power capacity, that could control and balance charging through scheduling algorithms that met the needs of the PEV and facility owners. The recipient also demonstrated how the system can be used by facility (e.g., garage) owners to save money through demand charge reduction and demand response, while supporting their employees or customers.</td></tr>
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APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets

[EPC-14-057]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/4/2015 to 3/30/2018

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

Plug-in electric vehicle (PEV) charging presents new challenges for building and fleet owners and grid operators. PEV charging can add substantial power draw to a facility, and when several PEV chargers are co-located, the building or fleet owner is likely to face substantial demand charges. For grid operators, PEV charging can add substantial loads during periods when the grid is already stressed. Currently, no commercially-available solutions exist for intelligently coordinating vehicle charging by either responding to automated demand response signals, by mitigating demand charges, or by offering PEVs as a resource for the wholesale market.

Project Description:

This project developed and demonstrated a managed charging system applied to more than 25 Alameda County fleet electric vehicles and charging stations. The researchers also developed approaches to engage non-fleet electric vehicle owners who charge their vehicles at Alameda County's publicly available charging stations and managed their charging station loads to further reduce utility costs. Although the project focused on one-way (uni-directional) charging, the approach is compatible with future vehicles and chargers that may have two-way (bi-directional) charging capability. The research had three main technical tasks: Task 1 - Characterize site and fleet, collect charging session and meter data, and analyze data for control strategies; Task 2 - Implement and demonstrate fleet and public electric vehicles managed charging control system; Task 3 - Quantify the potential of fleet and non-fleet electric vehicles in the managed charging system as demand response capabilities in the retail and wholesale electricity markets.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project developed an aggregation system for smart charging PEV vehicles to provide demand response, mitigate demand charges, and leverage time of use rates. A charging control system was applied to a fleet of vehicles owned by Alameda County and to charging stations that are used by both county vehicles and the public. The project added systems for intelligent prediction of PEV loads and control algorithms to create a flexible, modular, and scalable solution for smart charging county fleet and public PEVs. The managed charging control system will enable growth in PEV adoption without straining current grid infrastructure. These approaches can also be applied to commercial and workplace charging and provide large benefits in managing peak electricity demand across California by helping consumers reduce or shift their electricity use during times when electricity demand is high.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1g, 1h, 2a, 3f, 4a, 4b, 5b

Lower Costs:

This project lowered costs for energy users by allowing them to participate in energy markets. In 2017, smart charging control strategies for fleet and direct current fast chargers were implemented in February and August independently. The primary period for public smart charging was from August to October. The total cost savings in 2017 were $2,651 which included $1,697 for fleet vehicles, $169 for public vehicles, and $785 for direct current fast chargers.

Environmental Benefits:

In an effort to reduce emissions from transportation, the state has a target of reaching 5 million zero emission vehicles on its roads by 2030 and 250,000 electric vehicle charging stations by 2025. Electric vehicle fleets will be key to helping California reach its ambitious climate change and air quality goals. Providing best practices for fleet operators will enable them to implement more electric vehicles and achieve emissions reductions while also keeping energy costs down.

Consumer Appeal:

Access to real time data and having control over charging is important to consumers. A mobile application was developed for simple and easy interaction for public participants. When the driver plugged in the vehicle and activated the charging session, the server sent a text message with a link to a webpage for the driver to submit and modify the charging request. Drivers provided estimated departure times and estimated travel distances in miles or energy (kWh) for the next trip. Drivers could check the charging status on the webpage at any time during the active session period.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$812,829</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,993,355</td><td colspan="2">EPIC Funds Spent:
$1,794,690</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Kisensum: $416,800 (16.5 %)
Bay Area Climate Collaborative: $25,000 (1.0 %)
County of Alameda, General Services Agency: $27,711 (1.1 %)
ChargePoint, Inc.: $45,743 (1.8 %)
The Regents of the University of California, Berkeley: $21,507 (0.9 %)</td><td colspan="2">Match Funding:
$536,761</td></tr>
<tr><td colspan="2">Leverage Contributors:
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$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 40 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project successfully demonstrated a set of smart charging strategies at an Alameda County parking garage. Highlights include development of separate smart charging system platforms to meet the different requirements of each application (i.e., fleet vehicles, public vehicles, and the direct current fast charger); recruitment of public charging users to participate; public PEV managed charging to achieve utility bill savings by managing peak demand; and quantification of the potential of the fleet PEV managed charging system for multiple demand response products in California electricity markets. As a result of this project, LBNL was able to further build out the MyFleetBuy tool to help fleet owners incorporate PEVs into their fleet. LBNL is working with Alameda, Oakland, and Caltrans to help facilitate PEV smart charging technologies into their large-scale fleet procurement processes.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Laguna Subregional Wastewater Treatment Plant Microgrid

[EPC-14-059]

Recipient/Contractor:

Trane U.S., Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	8/27/2015 to 3/30/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

Critical facilities are vulnerable to climate change impacts, such as wildfires, that can disrupt the normal delivery of energy. Microgrid technologies are capable of improving a facility's energy resilience and providing additional value. This demonstration of a microgrid at a wastewater treatment plant will develop a case study on the plant's ability to provide sanitary services during times of emergency and to maximize on-site renewable energy use.

Project Description:

This project is upgrading a wastewater treatment plant to use a microgrid with a solar photovoltaic system, energy storage, and a microgrid controller for increased resiliency and greater use of renewable energy.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will demonstrate that a microgrid at a wastewater treatment plant can operate without compromising water quality or negatively affecting plant operations. The EPIC funds greatly accelerate the commercialization timeline by demonstrating a functional microgrid that addresses challenges with integrating energy storage, on-site generation, and control components to improve resilience.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs:

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

This project will explore using on site renewables to lower the facility peak load, which will reduce operating costs at the wastewater treatment facility.

Public Health:

If successful, this microgrid will support a critical facility that is vital to maintaining public health in an emergency.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $187,080
EPIC Funds Encumbered: $4,999,804	**EPIC Funds Spent:** $2,584,459
Match Partner and Funding Split: City of Santa Rosa: $750,000 (10.3 %) Nuvation Engineering: $1,200,000 (16.5 %) Parker Hannifin Corp: $340,000 (4.7 %)	**Match Funding:** $2,290,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 31 out of 40 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The microgrid is finishing construction and all equipment is in place. The project team successfully received all permits from the city of Santa Rosa, which were delayed substantially because of the volume of permits being reviewed by the city after the wildfires. Completion of those permits has allowed the team to perform construction activities. Permit applications are in process for the Air Quality Management District and the PG&E interconnection. Once all permits are received the microgrid will be commissioned, and operational data will be collected.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstrate a utility-owned renewable based community microgrid at Borrego Springs California

[EPC-14-060]

Recipient/Contractor:

San Diego Gas & Electric Company

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/22/2015 to 7/31/2018

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

California needs to make better use of locally available renewable energy to increase resiliency and address climate change impacts, such as increased fires, severe storms, and heatwaves. Microgrid demonstrations are needed to show that high penetration renewable based microgrids are able to provide islands of stable, independent power using local renewable energy. This is particularly critical for communities at or near the end of a distribution line, which is also susceptible to outages from severe weather.

Project Description:

SDG&E and the project team demonstrated a utility-owned renewable based community microgrid at Borrego Springs California. The renewable based microgrid is able to island the entire community with a peak load of approximately 14 MW, serving approximately 2,500 residential and 300 commercial and industrial customers. The SDG&E microgrid utilizes a 26 MW PV system, two substation batteries, three distributed batteries and an ultracapacitor.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project demonstrated improved grid resiliency from using a high penetration renewable based microgrid. There was an immediate benefit to the Borrego Springs community of non-interrupted energy resources during power outages. The microgrid controller was also able to make greater use of the large local solar plant's renewable energy while avoiding adverse grid impacts by coordinating the operation of the various energy storage units with the solar energy output.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs:

Borrego Springs used to experience an average of four hours of outages per year between 2008 and 2012. By avoiding these outages, using Lawrence Berkeley National Lab's value of service estimates tool, the microgrid saves customers about $600,000 per year.

Greater Reliability:

The microgrid successfully islanded the community on multiple occasions during daylight and nighttime conditions demonstrating increased reliability. This microgrid included multiple assets which were originally designed to work independently, to instead work harmoniously together to provide greater reliability across the entire Borrego Springs community. This was not previously accomplished at this scale, across a community, with non-utility energy producing assets being used to increase reliability.

Environmental Benefits:

The single 26 MW solar array serving the microgrid represents a reduction of approximately 21,000 metric tons of CO2 per year when compared with fossil fueled generation.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $923,165
EPIC Funds Encumbered: $4,724,802	**EPIC Funds Spent:** $3,882,476
Match Partner and Funding Split: SMA America: $90,000 (1.4 %) San Diego Gas & Electric Company: $530,000 (8.2 %) OSISoft, LLC: $1,119,560 (17.3 %)	**Match Funding:** $1,739,560
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	31 out of 40 bidders	Group 2: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project was completed in July 2018. The Borrego Springs Microgrid project demonstrated a robust, renewable-based system that provides critical power during emergencies and planned outages, which are necessary when system upgrades and maintenance work are needed. Unlike behind the meter microgrids, the Borrego Springs Microgrid is the first true community microgrid for an entire city and not just for a single metered customer. A unique aspect of this microgrid is that the microgrid assets are located throughout the community where they are able to provide the greatest support. The final report is available at: https://www.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Learning from Real-World Experience to Understand Renewable Energy Impacts to Wildlife [EPC-14-061]

Recipient/Contractor:

U.S. Geological Survey

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	10/26/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

There is a general lack of data to adequately determine some impacts of renewable generation on wildlife and habitat loss. This lack of understanding presents challenges to assessing, mitigating, and permitting new renewable energy development.

Project Description:

This research uses real-world data to understand renewable energy impacts to wildlife. The approach is to analyze observed wildlife fatalities and habitat loss to determine the significance of fatalities to population persistence; compare pre-construction predicted and post-construction actual impacts (fatalities) to sensitive species, as a foundation for improving predictive accuracy; and compare predicted and actual benefits of mitigation to sensitive species, as a foundation for improving predictive accuracy. The research goal is to produce a set of decision-making tools for renewable energy developers and permitting and regulatory agencies in California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is developing and applying a unique combination of stable isotope analysis and demographic modeling to characterize wildlife populations of interest affected by fatalities at renewable energy facilities in California. The project is also developing a novel application of techniques that evaluates statistical models to improve forecasting of wildlife fatality rates and mitigation outcomes. The approach will be high-tech, scientifically innovative, and ultimately subject to peer-review via publication in scientific journals. Implementation of this set of tools will benefit ratepayers by streamlining permitting and reducing costs of energy development and electricity.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 4f, 4g

Lower Costs:

This project is expected to help streamline environmental permitting management (improving reliability and cost). Likewise, improved prediction of fatality and mitigation outcomes allows for the streamlining minimization of compliance efforts, which reduces costs.

Greater Reliability:

Having a better understanding of impacts and how to mitigate them could lead to more capacity via new renewable energy developments and higher capacity factors (e.g., reduced curtailments).

Environmental Benefits:

Refining predictions associated with infrastructure development will reduce impacts to wildlife and improve mitigation effectiveness in future renewable energy development. The study is preparing recommendations for future pre- and post-construction surveys so that they are more useful for wildlife regulators and permitting agencies.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $262,924
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $223,108
Match Partner and Funding Split: US Geological Survey: $94,707 (3.6 %) University of Maryland Center for Environmental Studies Appalachian Laboratory: $22,470 (0.9 %) NextEra Energy: $1,500,000 (57.3 %)	**Match Funding:** $1,617,177
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	12 out of 14 bidders	Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

As of fall 2018, the project is transitioning from data analysis to the writing phase. The research team has compiled more than 600 environmental reports to review pre- and post-construction surveys at renewable energy facilities. About 3,000 samples have been prepared for isotopic analysis to determine the geographic origin of individuals. Together with experts, the research team developed a list of 34 species of five types on which to focus. Each type is being modeled with the most appropriate kind of demographic model using data from other parts of the project to estimate the effect of mortality at renewable energy facilities. The team has also shared sample material from carcasses found at renewable energy facilities with the team from EPC-15-043 to increase their database for genetic analyses. The study has already published two journal articles, with several more underway.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Energy Efficiency in California's Water Sector Using Customized Energy Management and Supervisory Control and Data Acquisition Systems

[EPC-14-062]

Recipient/Contractor:

The Regents of the University of California on behalf of the Riverside campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	7/1/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Many water and wastewater treatment facilities in California have a variety of older energy consuming equipment from different vendors each having their own unique communication protocols. Upgrades, modernization and integration of control equipment of various vintages present serious communication challenges for optimizing energy efficiency and peak demand management.

Project Description:

This project involves setting up links using software and hardware at pumping stations for water delivery, storage or treatment that enable the integration and transmission of data from energy meters directly or indirectly into Supervisory Control and Data Acquisition (SCADA) systems that are traditionally set up to monitor water quality parameters in real time. Combined with historical energy use data on the platform operators can manage systems in real time to monitor and control peak demand.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will highlight a pathway for water and wastewater agencies in California to increase energy efficiency and reduce their peak energy consumption with no decrement in service or reliability by monitoring real time energy consumption. This project provides equipment energy data to the water district operators, who can make decisions on optimal equipment operation. Ultimately, better pump and other equipment management will reduce energy costs; especially during peak demand periods when energy costs are most expensive.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a

Lower Costs:

The project is expected to reduce energy costs for California water treatment facilities due to lower energy and demand costs. The estimated cost savings for the three water districts participating as host sites for this project is approximately 10 percent ($4.6 million) with an annual reduction in electricity consumption of 100 GWh and electrical demand of 37.2 MW.

Environmental Benefits:

By lowering peak demand, the project could reduce greenhouse gas (GHG) emissions. Fast start peaker plants used during periods of peak demand; particularly on the hottest days of summer typically produce more GHG and criteria air pollutant emissions. The estimated annual reduction in GHG emissions is 28,300 metric tons of carbon dioxide equivalent.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $452,544	
EPIC Funds Encumbered: $3,017,034		**EPIC Funds Spent:** $967,406	
Match Partner and Funding Split: Opto 22: $94,198 (2.0 %) OSISoft, LLC: $1,081,469 (22.8 %) Regents of the University of California, Riverside Campus: $123,709 (2.6 %) Cucamonga Valley Water District: $198,896 (4.2 %) Inland Empire Utilities: $115,360 (2.4 %) Olivehain Municipal Water District: $109,100 (2.3 %)		**Match Funding:** $1,722,732	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 6

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research team continues to monitor the energy system data from all three water districts while also discussing potential for additional demand reduction based on data collected and trends. As the project approaches the end of the agreement term, the research team will be finalizing the last stages of technology transfer and independent verification and validation. The individual water districts will be interfacing the Energy Management System with their existing operation and SCADA network. A public workshop is planned in early 2019 to communicate their findings to the public.

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Project Name:

Advance Wastewater Treatment Using Forward Osmosis to Produce High Quality Water [EPC-14-063]

Recipient/Contractor:

Porifera, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Industrial-scale wastewater treatment systems have the potential to save energy, reduce wastewater volumes, and generate pure water streams for on-site re-use. However, many industrial wastewaters are very difficult to treat, as they contain high levels of dissolved and suspended solids, making low cost treatment with membrane-based systems ineffectual.

Project Description:

This project demonstrates an advanced wastewater treatment technology, the PFO Recycler, that produces high quality water while reducing energy, chemicals and maintenance required for treatment of industrial wastewaters. The PFO Recycler uses forward osmosis to extract the water from the waste stream and reverse osmosis to extract the water out of the forward osmosis draw solution. If the project is successful, then this technology could be used to treat challenging wastewaters to achieve high purity and provide high temperature water for reuse while using less energy than other processes. Reclaiming water for onsite reuse will reduce the need for fresh water purchases.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project includes technological advancements in membrane development and module design in forward osmosis to address cost and performance issues. The demonstration projects are located at a winery, frozen food facility and a soap company. Each demonstration is documenting energy savings and potential for this technology to purify, concentrate and reuse challenging wastewaters that contains high levels of contaminants. This technology has the potential for application in the food and beverage, oil and gas, and other industrial sectors.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a, 4c

Lower Costs:

This technology treats challenging industrial wastewaters for water reuse and can result in energy and water saving benefits and cost savings. Preliminary results estimate 15-30 percent energy savings compared to competing technologies while also reusing about 50 percent of the wastewater for internal use. This results in reduced operating costs. In the past all of the wastewater was disposed through the local wastewater treatment plant.

Environmental Benefits:

By reducing electricity use and water use, the project could reduce greenhouse gas emissions. With broad adoption, the technology could enable the reuse of industrial wastewaters rather than being disposed in the sewer system. The reuse of wastewater minimizes the need for fresh water.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $964,131	
EPIC Funds Encumbered: $3,230,420		**EPIC Funds Spent:** $2,145,462	
Match Partner and Funding Split: Porifera, Inc.: $364,600 (9.4 %) TBD - General Contractor: $14,500 (0.4 %) Lawrence Berkeley National Laboratory: $88,008 (2.3 %)		**Match Funding:** $646,493	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Porifera has finished collecting the data from the Jackson Family Wines project site and is analyzing the data. Recipient is collecting data from the Ale Industries site and initiating work on the Dr. Bronner's site demonstration.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Aerosol Impacts on the Hydrology and Hydropower Generation in California

[EPC-14-064]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Riverside Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/13/2015 to 6/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Hydrologic forecasts for hydropower units can have substantial errors. This hampers the efficient management of hydropower units. Hydropower is a very important clean resource that provides peak generation in hot summer months and can provide electricity when wind and/or solar resources go down. Improving hydrologic forecasts could substantially increase these and other benefits obtained from hydropower units. Simulating the effect of aerosols (small particles in the air) into clouds and precipitation is a very promising option to improve weather/climate forecasts.

Project Description:

The research team enhanced and used a fully coupled aerosol-meteorology-snowpack forecast model for hydropower applications, using observational datasets (precipitation, snowpack, stream inflow) for Southern California Edison's hydropower plant on Big Creek. The main goal was to estimate the impacts of aerosols on hydropower generation and explore the use of improved forecasts to improve the management of hydropower units.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The proposed research is intended to significantly advance our knowledge of aerosol impacts on the hydrology and hydropower generation in California. The results of this project are expected to improve the management of hydropower units which should reduce overall electricity generation costs and assist with adaptation under a changing climate.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1c, 4a, 5c

Lower Costs:

The improved forecast should maximize California ratepayer benefits by increasing the hydroelectric power plant's availability, flexibility and revenue in the wholesale electricity market.

Environmental Benefits:

Improved hydropower management will foster the use of a clean and flexible generation resource during peak hours.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:

Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:

$92,951</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:

$399,818</td><td colspan="2">EPIC Funds Spent:

$275,680</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:

University of California, Riverside: $56,262 (8.0 %)
University of California Los Angeles: $249,975 (35.4 %)</td><td colspan="2">Match Funding:

$306,237</td></tr>
<tr><td colspan="2">Leverage Contributors:

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$0</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

12 out of 14 bidders</td><td>Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The research team successfully ran a chemistry-aerosol-meteorological model and coupled this model with a model used by Southern California Edison (SCE) to operate their Big Creek Hydroelectric System. The modeling results suggest that aerosols induce a reduction of annual inflows on the order of 4% to 14% but that the reductions are more significant in the summer. The research team calculated the loss of generation and revenue and found that aerosols reduce hydropower generation by about 6%, which is equivalent to an annual loss of about $3 million a year. The final report was submitted and will be posted in the near future. The researchers have shared results with others via scientific conferences and journal publications. SCE was heavily involved with the research team during the execution of the project and co-authored a conference paper with the research team.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstration of Forward Osmosis to Produce Juice Concentrate, Purify and Reuse Wastewater and Reduce Energy Use

[EPC-14-065]

Recipient/Contractor:

Porifera, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

There is a need for energy efficient methods to concentrate food and beverage products and wastes under varying processing conditions and operations while preserving or improving product quality. Food and beverage industry operators are eager to implement new methods, but first need to be convinced of the effectiveness and efficiency of the technology without compromising the high quality standards of California's food and beverage products.

Project Description:

This project is demonstrating a new technology innovation, the PFO Concentrator, to reduce the energy, chemicals, and maintenance required for food and beverage processing and waste concentration. The PFO concentrator dewaters fruits and vegetables for production of food and beverage concentrates and purees and could replace energy intensive thermal evaporators. Additionally, water is extracted from the concentrated product for reuse on-site.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The technology uses forward osmosis and reverse osmosis in an energy efficient way to achieve the equipment performance of an evaporator and, in addition, generates purified water streams for reuse. This technology could lower energy use and costs for food processing and industrial operations through replacement of energy intensive thermal evaporators and reuse of wastewater streams onsite, rather than disposed through the municipal system.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

APPENDIX B:
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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 4a, 4c

Lower Costs:

The PFO concentrator could save approximately 80 percent of thermal and electrical energy compared to conventional technologies and water reuse of greater than 50 percent. This results in additional cost savings and negates the need to purchase potable water from local jurisdictions.

Environmental Benefits:

Since this technology could lower energy use and eliminate the use of evaporators which burn natural gas, it could lower greenhouse gas emissions. Also the project has the potential to purify wastewater for on-site reuse, thereby lessening need for fresh water purchases, while reducing water disposed through the sewer system.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:

Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:

$621,536</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:

$2,499,289</td><td colspan="2">EPIC Funds Spent:

$1,944,097</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:

CDM Smith, Inc.: $9,885 (0.3 %)
Porifera, Inc.: $233,108 (7.5 %)
Los Gatos Tomato: $385,575 (12.3 %)</td><td colspan="2">Match Funding:

$628,568</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:

$0</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders</td><td>Rank of Selected Applicant/ Bidder:

Ranked # 7</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

Porifera is working on regulatory approval for food contact with the PFO Concentrator at Los Gatos Tomato and has begun testing and data collection at the facility. Testing at the Anheuser-Busch site continues and data collection is underway. Testing the PFO Concentrator at Jackson Family Wines is complete, and product quality and data are being analyzed.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: High-Performance Integrated Window and Facade Solutions for California Buildings [EPC-14-066]	
Recipient/Contractor: Lawrence Berkeley National Laboratory	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/30/2015 to 3/29/2019
Program Area and Strategic Objective: Applied Research and Development S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector	
Issue: Building envelope systems directly affect electricity use for lighting and heating, ventilation and air conditioning (HVAC). These systems have a major impact on annual energy use, load shape, and peak demand. Better envelope system designs can play a significant role in helping to achieve state policy goals such as zero net energy (ZNE) buildings by 2030 and capturing aggressive savings in existing buildings beyond current best practice. However, many potentially high performance window and building envelope technologies and systems have struggled to gain significant market share due in part to cost and the complexity of providing market-ready business solutions.	
Project Description: This project develops, validates and quantifies energy impacts of a new generation of high performance building envelope systems such as highly insulating windows, novel window-integrated local ventilation, and dynamic daylight-redirection. It will provide design and management toolkits that will enable the building industry to meet challenging energy performance goals leading to zero net energy buildings. This project considers cost-effective integrated system approaches to reduce energy use associated with HVAC and lighting while improving occupant comfort.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Almost all building envelope products offered on the market today address a narrow, component-oriented set of performance goals often set by prescriptive codes, e.g. a U-value, with only a limited consideration of the broader tradeoffs possible in the context of whole-building performance. This project uses an integrated systems approach that aims to improve the performance and cost of highly insulating (Hi-R) windows, window-integrated ventilation systems, and dynamic daylight redirecting systems. Supporting tools, data, and design	

<table>
<tr><td colspan="4">methods are also being developed to facilitate widespread, reliable, cost-effective deployment throughout California. These solutions could lower energy use and demand in buildings due to reduced HVAC and lighting loads while also reducing building owner operating costs.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a
Lower Costs:
The technologies in development are estimated to be capable of reducing statewide energy use by 5755 gigawatt-hours and peak electricity demand by 2250 megawatts resulting in lower electricity costs of $816 million/year, assuming 75 percent market penetration in new and existing commercial buildings.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$1,308,746</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$3,000,000</td><td colspan="2">EPIC Funds Spent:
$3,000,000</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
United States Department of Energy: $450,000 (13.0 %)</td><td colspan="2">Match Funding:
$450,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
United States Department of Energy: $450,000</td><td colspan="2">Leveraged Funds:
$450,000</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 10</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-066 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

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Update:

Progress this year includes developing an improved window system (R-5 performance), prototyping a window-integrated ventilation system to maximize use of natural ventilation, and designing and testing a daylight-redirecting system that increases daylight up to 40 feet from the window. Supporting tools and control systems were also developed to facilitate the design and automated operation of integrated solutions that optimize building electric loads while maintaining occupant comfort. Market outreach activities included collaborating with industry partner Alcoa to work out essential design elements of the window frame for mass manufacturing, and incorporating modeling tools into third-party software such as Honeybee, and LightStanza which are used by industry to develop rating and certification programs for window attachments. Draft final report is anticipated December 2018.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems

[EPC-14-067]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/29/2015 to 8/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S4: Develop Emerging Utility Scale Renewable Energy Generation Technologies and Strategies to Improve Power Plant Performance, Reduce Costs, and Expand the Resource Base

Issue:

Next-generation hydrographic data networks are needed to better measure and predict critical snowpack levels that can help hydropower operators adjust to increased variability and precipitation consequences of climate change.

Project Description:

The project will advance hydrologic modeling and improve the Precipitation-Runoff Modeling System (PRMS) used by PG&E allowing for more effective management of hydropower resources. The goals will be achieved using innovative smart wireless sensor network made up of small sensor stations mounted on poles linked by low-power radio, which produces real-time hydrologic data. These data, blended with satellite and Light Detection and Ranging (LiDAR) remote sensing data, have the potential to greatly improve hydrologic forecasting for the Sierra Nevada and other areas in California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project provides improved predictive planning and scheduling tools to manage hydroelectric resources that are needed to adapt to increasing vulnerabilities and uncertainties of a changing climate. This project specifically targets powerhouses operated by PG&E.

CPUC Proceedings addressing issues related to this EPIC project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019 Water-Energy Nexus: R.13-12-011 [Closed]

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Applicable Metrics: CPUC Metrics- 2a, 3a, 5c

Lower Costs:

The tools developed and enhanced by this project increase the ability of hydropower to respond to fluctuations in demand and supply, resulting in lower cost of energy production.

Greater Reliability:

The quality of hydrologic data collected using installed remote sensing network and Snowpack Water Equivalent (SWE) maps derived from bi-weekly Light Detection and Ranging (LiDAR) scans show an improvement of 55% compared to the prominent Snow Data Assimilation System (SNODAS) results. The new methodology allows measurements of interception and radiation impacts to vegetation, and will be especially useful for hydrologic forecasts for areas affected by wildfires. The updated PRMS version used by PG&E will reflect runoff changes due to the burn scars.

Environmental Benefits:

Better, more-detailed, real-time predictions for water basin-runoffs will increase the hydropower availability and contribute to the mitigation of climate change effects.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $205,897	
EPIC Funds Encumbered: $1,100,000		**EPIC Funds Spent:** $248,903	
Match Partner and Funding Split: University of California Merced: $86,263 (6.5 %) California Department of Water Resources: $150,000 (11.2 %)		**Match Funding:** $236,263	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 14 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The research team has installed hardware at all four project sites: Grizzly Ridge, Kettle Rock, Buck's Lake, and Humbug and has collected hydrologic data for water years 2016 and 2017. Data from in-situ snowpack measurements helped to improve Snowpack Water Equivalent (SWE) maps by 55%. The team is currently working with PG&E on updating their working model of the Precipitation Runoff Modeling System (PRMS) from version 2 to version 4 using findings from the project. Some of the project results has been already published in the California 4th Climate Change Assessment Report. In the upcoming months, the team will collect hydrologic data for the final water year 2018 of the project and publish two PRMS-related papers.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Evaluation of Cost, Performance and Water Conserving Capability of Hybrid Cooling [EPC-14-068]	
Recipient/Contractor: Maulbetsch Consulting	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/13/2015 to 1/31/2018
Program Area and Strategic Objective: Applied Research and Development S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts	
Issue: The need for increasing amounts of electric power and clean water have sometimes come into conflict in California. Hybrid, wet/dry cooling systems enable significant water savings in comparison to wet cooling and improve plant efficiency and output in comparison to all-dry systems. To expedite the introduction of hybrid systems, a methodology and computational tool to provide regulators, planners and potential users with reliable, validated comparative performance and water use cost comparisons with optimized wet and dry cooling systems is needed.	
Project Description: This project analyzed the design, performance, and cost of optimized hybrid cooling systems at utility power plant scale to illustrate the potential benefits of hybrid cooling in California. This project uses an existing Excel spreadsheet-based computational tool with the capability of specifying, at an "engineering-level", design parameters for optimized closed-cycle wet, direct dry, and parallel wet/dry hybrid cooling systems. The tool's output is checked against information from participating plants equipped with wet, dry, and hybrid cooling systems. The capability to make rigorous, reliable evaluations of hybrid cooling systems and the trade-offs between economic power production and water resource conservation enables the selection of preferred cooling systems for the economic and environmental benefit of California.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Hybrid cooling can save substantial amounts of water compared to the traditional wet cooling systems, although there are increased system costs and potentially reduced hot day generating capacity and annual energy production. The results of this study provide	

information validated by a computer methodology to determine quantitative estimates of the trade-offs among cooling system cost, annual energy production, and water consumption. State regulatory agencies, power system developers and owners, and community groups can use this information to make informed decisions about the most suitable cooling equipment to use at future steam power generating facilities in California. This will help ensure the appropriate balance among the supply of electrical generation, the cost of electricity, and conserving water resources.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 2a, 3a, 4c

Environmental Benefits:

The project is expected to reduce the water required to keep plants operating in comparison to traditional wet cooling. Estimations for annual water use (in kgal/yr) for three hybrid systems show that water consumption decreases by 15% to 50% (depending on site meteorology) compared to an all-wet cooling system. The tool can be used to determine where hybrid cooling systems would result in optimizing plant performance, balancing power output and water consumption. Findings were presented at the Annual Winter Meeting of the Cooling Technology Institute (CTI) in Houston on February 5, 2018 and in the CTI Journal, and at International Heat Transfer Conference in Beijing, China in August 2018.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $581,580		**EPIC Funds Spent:** $545,174	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 14 bidders	**Rank of Selected Applicant/ Bidder:** Group 4: Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. The Recipient has identified an unregistered Spreadsheet Tool software as "project relevant pre-existing intellectual property" in agreement EPC-14-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The final report was submitted in December of 2017 and published in July 2018 at https://www.energy.ca.gov/2018publications/CEC-500-2018-015/CEC-500-2018-015.pdf. Results included: 1. Validating the tool output against existing cooling systems. The estimates generated by the tool were comparable to the design and performance of existing systems at full-scale power plants. 2. Comparing costs, performance, and water consumption in differing meteorological conditions as illuminated in the case studies. The team concluded that while the installed cost and the turbine output reduction vary significantly with cooling system choice, the annualized costs do not. 3. Projecting effects of using hybrid cooling at California power plants in the future.

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Project Name:

Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System

[EPC-14-069]

Recipient/Contractor:

Energy and Environmental Economics, Inc. (E3)

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/13/2015 to 1/31/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

If California is to achieve its long-term goal of reducing greenhouse gas emissions 80 percent below 1990 levels by 2050, the electricity system must play a pivotal role. Electricity generation must have significantly reduced carbon intensity and much of transportation and other end uses that are currently powered by direct fossil fuel combustion must be electrified. Prior research has identified "proof of concept" low carbon scenarios, but many aspects of the energy transition remain poorly understood.

Project Description:

This project advances the understanding of key parameters of long-term energy scenarios and greenhouse gas abatement options in the California energy system. Researchers further developed detailed scenarios and modeling capabilities of the California electricity sector, as well as interactions between the electricity sector and other sectors, and explored the implications of particular policy choices on the electricity system in the medium (2020-2030) and long term (2050). This project provides critical insight into some of the key challenges facing the low carbon transition in the electricity system, the options for addressing these challenges, and the dynamic interactions among these options, which are likely to grow more important over time.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project developed options for improving electricity planning methodologies, such that they better incorporate knowledge of how the electricity system will need to evolve over the next 15 to 30 years. The analysis includes a better understanding of how current policy choices will impact long-term climate outcomes, providing critical policy-relevant information to state energy agencies that will be implementing the Governor's energy and climate goals

over the next 15 years. The research team estimated the potential costs of reducing GHG emissions by 80% by 2050 and compared these costs with the public health benefits of improved air quality reported by others. They found that the potential public health benefits are in the same order of magnitude than the potential GHG reduction costs.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed]

Applicable Metrics: CPUC Metrics- 3f, 4a

Lower Costs:

This research provides information to policy makers about key choices that would lower the cost of meeting the state's environmental goals in the electricity sector. This project per se will not lower costs but it is providing information that can be used to develop and implement policies for the energy sector.

Greater Reliability:

This project provides information to policy makers about the key choices and decisions needed to maintain electric reliability of the future system with increased renewable and distributed generation. The scenarios explored by the research team have implications for prioritizing planning in technological development & demonstration and grid integration activities necessary to decarbonize the electricity system while improving resilience in a changing climate.

Environmental Benefits:

This project investigates the environmental and land use implications of different renewable development scenarios under a 50 percent renewable future in 2030 while reducing environmental impacts.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $286,936
EPIC Funds Encumbered: $700,000	**EPIC Funds Spent:** $629,929
Match Partner and Funding Split: N/A	**Match Funding:** $0

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<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
12 out of 14 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 5: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The researchers improved their models and data sets, for example, improving the linkage between the E3 model of the electricity system and their PATHWAY model. E3 briefed Chair Weisenmiller and the project's Policy Advisory Committee in November 2017. The final project report is published on the Energy Commission website. Key findings of the long-term energy scenarios research include: 1) renewable power generation needs to exceed the current RPS requirement of 50% set for 2030 if the 2030 emissions reductions goal is to be met; 2) to meet California’s 2050 goal of 80% emissions reductions relative to 1990 levels, the electricity system must be comprised of 85-95% zero-carbon electricity by 2050; 3) consumer behavior is the lynchpin to meeting 2030 targets; and 4) additional RD&D is needed to chart a path for hard-to-electrify end-uses (e.g., heavy-duty trucks, industry).</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Wexus Energy and Water Management Mobile Software for the Agricultural Industry

[EPC-14-070]

Recipient/Contractor:

GDRU Energy Solutions LLC (dba Wexus Technologies)

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California's agricultural industry is one of the state's largest users of energy and water and has been historically underserved by a lack of effective efficiency technologies. The agriculture industry is also rapidly transitioning to the next generation of technology: mobile, cloud-based software, big data, and connected devices in the field. The combination of rising energy rates, increasing regulation and reporting, drought and changing weather patterns is driving demand for new agricultural energy efficiency solutions. Farmers currently cannot manage what they do not measure, leading to higher operational costs for farms.

Project Description:

This project deploys the Wexus (Water-Energy Nexus) mobile, cloud-based software platform in California's agricultural industry. The Wexus platform leverages existing utility meter infrastructure and helps agribusinesses to quickly assess energy (and water) usage and cost from virtually anywhere on any mobile device. Through customized alerts and reporting, the platform allows farms to quickly respond to changes in energy usage, adjust and optimize equipment in the field, and reduce operational expenses due to energy costs. Through collaboration with project partners, this project will further extend existing water-energy data analysis, visualization and remote controlling capabilities to the Wexus platform to further optimize water-energy resource management in the agribusiness sector.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The Wexus platform uses site data and electric and water utility data to estimate how energy is used on-farm. The data is translated into reports and informs the farmer when to turn off equipment in order to participate in demand response programs. The technology could save farmers about 10% in energy and water bills.

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<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e, 1f, 1h
Lower Costs:
The project could reduce energy costs (and water costs where possible) for California farmers who may use Wexus Software solution to monitor their onsite electricity and water use. The estimated savings over three years for the four demonstration farms: 2.4 million kWh, 4000 acre feet of water, 600 metric tons of GHG emissions and more than $400,000.

Greater Reliability:
Using the Wexus Software, California farms could reduce their demand and make informed decisions on the cost/benefit of participating in utility sponsored demand response programs while also contributing to grid flexibility.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$571,397</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$4,000,000</td><td colspan="2">EPIC Funds Spent:
$3,226,601</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Wexus Technologies, Incorporated: $1,000,000 (20.0 %)</td><td colspan="2">Match Funding:
$1,000,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

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Update:

The final monitoring and verification (M&V) report, prepared by UC Davis in November 2018 indicated that three of the four participating farms had substantially lower average electricity use during the project period relative to baseline period. After accounting for external factors such as climate, the change in total electricity use was 5.6 percent decrease for the berry farm, 1.8% decrease for the row crop farm, 7.3 percent increase for the dairy farm, and a 12.7 percent decrease for the winery. The increase in the dairy was likely due to uncontrolled variables such as significant variability in pump usage over time, long periods of non-use due to crop irrigation cycles, and unavailable utility data for 2018 (project team working with SCE to address this issue).

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Rotor-Mounted Bat Impact Deterrence System Design and Testing

[EPC-14-071]

Recipient/Contractor:

Frontier Wind

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Measures put in place to mitigate the impact of wind generation facilities on wildlife species, including bats, limit the achievement of key state objectives for renewable generation. These mitigation measures serve to limit the productivity and ability to develop and construct new wind energy projects. Developing more effective technology and methods to mitigate fatal interaction of bat species with wind turbine facilities could enable wider deployment of wind energy with less curtailment.

Project Description:

The project designs and tests (in lab and field) a new bat deterrence system using ultrasound transmitters mounted in an array along the rotor blades, providing complete coverage over the entire rotor/nacelle envelope. A field test study using substantially similar methods to prior bat impact studies is being implemented post-installation at the test site to measure the effectiveness of the new ultrasound system.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will create the wind industry's first bat impact deterrent system that can effectively prevent fatal bat interactions with wind turbines. Success of the project has potential to yield a transformational impact on the field of bat impact mitigation. An effective, practical, cost effective system design and test can enable commercialization and broad deployment of this technology. As a system that can be retrofitted into existing turbines and installed in new wind turbines, this technology could materially overcome a significant challenge of the wind power industry by reducing bat fatalities and injuries from turbine strikes while avoiding costly curtailments.

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 4g

Lower Costs:

Currently available mitigation measures can be costly to ratepayers through forced curtailments and limit achievement of State renewable capacity expansion goals. As such, the project benefits ratepayers by providing a less costly alternative approach.

Environmental Benefits:

The project is developing new technology that could significantly reduce bat fatalities at wind energy facilities in California and globally.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $104,801
EPIC Funds Encumbered: $862,875	**EPIC Funds Spent:** $642,337
Match Partner and Funding Split: Frontier Wind: $22,313 (2.5 %) Bruce Walker: $14,000 (1.6 %)	**Match Funding:** $36,313
Leverage Contributors: United States Department of Energy: $249,000	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 6: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-071 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

Researchers completed the design stage for the system and tested it in their lab. The full system was installed on twelve turbines at Hatchet Ridge in 2016. Bat fatality surveys were conducted on the test turbines and control turbines during the Fall 2016 bat migration season. Power supply problems disrupted the field testing, limiting the amount of useful data. Problems with the power supplies were diagnosed and resolved in 2018, but smoke from the Carr Fire prevented installation in time for the 2018 bat migration season. The team is attempting to secure match funding to cover the cost of completing the bat fatality surveys in 2019 to give a statistically robust estimate of the effectiveness of the system to reduce fatalities.

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Project Name:

Monitoring the Urban Heat Island Effect and the Efficiency of Future Countermeasures

[EPC-14-073]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/29/2015 to 12/31/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

The prevalence of dark, dry surfaces and human-caused heat in cities creates Urban Heat Islands (UHIs) with elevated air temperatures. UHI countermeasures, such as reflective surfaces and urban vegetation, can save cooling energy, improve thermal comfort in summer, reduce pollutant emissions, and improve health. These measures may also help counter potential microclimate, emissions, and air-quality impacts of climate change. However, there has been little empirical validation of on-the-ground benefits of countermeasures. This study gathers high-resolution, real-world data to clarify determinants of UHI effects and sets the stage for improving quantification of countermeasures.

Project Description:

This project evaluates the distribution of air temperatures within urban heat islands in California and enhances the foundation for location-specific assessments of mitigation strategies. In collaboration with local governments and organizations in the Los Angeles Basin, the research team designed and implemented siting of fixed high-quality monitoring stations, supplemented with mobile monitoring and data from existing weather-station networks. This research assesses spatial and temporal variations in near-surface air temperature and recasts these observations for use in validating and calibrating the climate/meteorological models applied to assess potential benefits of urban heat island countermeasures throughout the state.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Research improves on-the-ground benefits from urban heat island (UHI) mitigation by verifying relationships between the UHI effect and land use/land cover; using these measurements to calibrate and validate models that estimate benefits of mitigation measures; establishing a baseline of today's UHI effect against which the efficacy of future

<table>
<tr><td colspan="4">UHI mitigation (cool community) programs can measured; and leaving in place a set of research-grade monitors that can be used to track changes in the UHI effect.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 4a
Greater Reliability:
Extensive prior research indicates that urban heat island (UHI) mitigation attainable through cool community strategies can save electricity, reduce peak power demand, lower strain on the electrical grid, and increase reliability. This research project will facilitate regionally optimized deployment of UHI mitigation technologies.

Public Health:
UHI mitigation can reduce air pollutant emissions and slow production of ground-level ozone, thus improving air quality and protecting public health. The research project will help ensure that future UHI mitigation efforts maximize public health benefits associated with reducing ground-level ozone concentrations and improving air quality.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$116,818</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$500,000</td><td colspan="2">EPIC Funds Spent:
$500,000</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Altostratus, Inc.: $4,000 (0.8 %)</td><td colspan="2">Match Funding:
$4,000</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
12 out of 14 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 7: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

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Update:

Having successfully engaged the LA Unified School District in siting of research grade weather stations, and developed a mobile monitoring platform for urban heat island (UHI) effects through strategically charted transects, the team completed its collection and analysis of empirical data portraying urban heat island phenomena in the Los Angeles basin. A final report passed the rigorous peer review process associated with California's Fourth Climate Change Assessment. New findings include identification of dominant determinants of urban heat island impacts in the San Fernando Valley and downtown Los Angeles study areas, namely low vegetation canopy cover and low albedo, respectively. Another key contribution was development of a methodological framework for siting weather stations, monitoring urban heat islands, and empirically substantiating strategies to address UHI.

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Project Name:

Building a Climate Change Resilient Electricity System for Meeting California's Energy and Environmental Goals

[EPC-14-074]

Recipient/Contractor:

The Regents of the University of California, Irvine Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 7/2/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

The energy system needs to respond to the impacts of climate change, such as increased precipitation extremes, higher peak energy demand from hotter and more frequent temperature extremes, and damage to energy infrastructure. At the same time, the energy sector must comply with mandates to reduce greenhouse gas emissions. These two pressures (climate impacts and changes in energy policy) interact in complex ways on the existing grid. To support future planning, this project estimates how climate change would interact with efforts to reduce GHG emissions and to comply with renewable energy targets.

Project Description:

The project used climate change simulations to model conditions that disrupt electricity system generation, renewable capacity potential, and demand for the years of 2030, 2040, and 2050. The combined effect of these impacts was then simulated on the electricity system using an integrated electric grid modeling platform to determine the shortfall in achieving California's greenhouse gas emissions goals. The project then analyzed the potential benefits of additional mitigation strategies, such as additional energy storage, on reducing emissions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The primary benefit of this study was addressing a knowledge gap that has hampered energy planners and policy makers. Previous energy planning studies for the state assumed that future climate would be the same as historical or that climate change would have no impact on the energy system. This study revealed that feedback from climate change could disrupt strategies designed to meet California's greenhouse gas reduction and renewable energy

goals for 2050. The study also found that the potential shortfalls caused by climate change could be overcome with existing technologies, perhaps aided by policy changes.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Strategies and Guidance for Climate Change Adaptation: R.18-04-019 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 4a

Environmental Benefits:

The study provides policy makers and ratepayers a clearer understanding of the importance of water resources, and therefore water conservation and management, in supporting a low-carbon energy system. The effects of water availability on hydropower generation and on the potential expansion of solar thermal and geothermal capacity have implications for grid operation (such as ancillary services) and greenhouse gas emission levels.

Energy Security:

The project includes analyses of robust energy systems. Robustness can be simulated and tested to produce results to inform which set of technologies in which places are the most resilient to climate change, and therefore more energy secure.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $181,613
EPIC Funds Encumbered: $698,792	**EPIC Funds Spent:** $661,629
Match Partner and Funding Split: Southern California Edison: $150,000 (15.0 %) Southern California Gas Company (SoCalGas): $150,000 (15.0 %)	**Match Funding:** $300,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	12 out of 14 bidders	Group 5: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-074 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project was completed in 2018 and provided an understanding of the specific effects of climate change on the electricity system by 2050 and the resulting ability of the system to satisfy California's GHG reduction target. Because the baseline energy scenario did not account for climate change and fell short of the GHG target, the project team explored a set of energy technologies and resource management strategies to determine if they could offset the shortfall. The project generated a more realistic energy scenario for achieving the 2050 GHG target at the lowest cost. This project was conducted in collaboration with two related studies led by Energy and Environmental Economics (EPC-14-069) and Lawrence Berkeley National Laboratory (EPC-14-072), and results of these three studies have been presented to policy makers and legislative staff. Three journal papers were published.

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Project Name:

Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems

[EPC-14-075]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Historically, industrial facilities have paid little attention to electricity consumption. Many industrial customers are unaware of low-cost energy conservation and energy efficiency opportunities. Often the only electricity data available is at the whole facility level and cannot be easily analyzed to find energy-saving opportunities. Process-level sub-metering has been rare due to its historically high costs and it is typically not used to find ways to lower energy costs. Energy management systems that use real-time data and analysis to identify energy savings are not available in the market.

Project Description:

The University of California at Berkeley, Massachusetts Institute of Technology, and the University of Chicago, have partnered with Lightapp Technologies to demonstrate a pre-commercial, software-based, optimized energy management system in industrial facilities. Together, they will demonstrate Lightapp's energy-monitoring system on compressed air systems in 100 California industrial plants served by the state's investor-owned utilities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The Lightapp technology takes an innovative approach by relating electricity use and operating measurements to the production outputs of specific facility systems. This project will monitor the compressed air systems over time, looking at both the supply side (the compressor) and the demand side (production). The software tool then identifies anomalies and makes recommendations to lower the overall energy intensity of production and save energy and money. This project demonstrates the operational effectiveness and financial viability of deploying a more developed version of the technology in California industries and optimizes electricity consumption in compressed air systems, a common system in many industries.

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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a

Lower Costs:

The project could lower energy use and costs by optimizing industrial processes in a variety of manufacturing sectors. Market assessments and technology deployed to date have estimated savings of 15% to 17% in compressed air system energy use with paybacks of less than 2 to 3 years.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $451,253
EPIC Funds Encumbered: $4,981,729	**EPIC Funds Spent:** $4,572,412
Match Partner and Funding Split: University of California, Berkeley: $1,530,590 (23.5 %)	**Match Funding:** $1,530,590
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 8

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

As of December 6, 2018, 93 installations are completed and communicating baseline data, with 61 sites in the data acquisition phase. When the results of all methods of analysis are averaged together, the demonstration facilities have seen an overall average decrease of 9% of electricity use and monthly savings of $6,728 per facility, equating to a yearly savings of $81,962 per facility.

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Project Name:

Raw Wastewater Filtration to Increase Organic Removal Efficiency and Achieve Significant Electrical Savings

[EPC-14-076]

Recipient/Contractor:

Kennedy/Jenks Consultants, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

The secondary biological wastewater treatment process is usually the most energy intensive process of a wastewater treatment plant (WWTP). The most common secondary biological treatment method is called the "activated sludge process", and is accomplished by aerating wastewater. On average the activated sludge process accounts for 40 to 60 percent of total WWTP electricity consumption. The electricity used for aeration is proportional to the organic load entering the aerated activated sludge process. Achieving a higher degree of removal of the organic load before the aerated activated sludge process provides a breakthrough opportunity to reduce electricity consumption.

Project Description:

This project is extending the application of Cloth Depth Filters (CDF) to raw wastewater filtration at three wastewater treatment plants in California. The CDF concept replaces the current technology of primary clarification by offering the following advantages: (1) substantially higher removal of organic load resulting in significantly lower aeration electrical power demand, and (2) smaller footprint requirements both for primary and secondary treatment steps. CDF employs established principles of gravitational forces which results in minimal operational and maintenance complexities. The unique attribute which offers promise for CDF technology in raw wastewater is the vertical placement of the filter medium and flow direction of this filtration process. Unlike prevailing filtration systems, the vertical orientation of the filter medium permits heavy solids to settle within the tank.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

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This project uses cloth depth filtration (CDF) for raw wastewater filtration to reduce the organic load on the secondary wastewater treatment step, which is the most energy intensive step in the treatment process. This breakthrough treatment using CDF has never been tested nor implemented at wastewater treatment plants. The technological breakthrough is proving the effectiveness and technical and economic feasibility of filtering raw wastewater for removal of biosolids before any other wastewater treatment step occurs. A reduction in biosolids loading before the primary and secondary treatment can lead to 35 percent reduction in secondary aeration energy use that will help these plants meet the state's SB 350 goals. The project team includes engineers, consultants end users and others who will work collaboratively to overcome barriers for market acceptance of the CDF technology.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a

Lower Costs:

The project could reduce the cost of wastewater plant operations within California by reducing wastewater treatment plant electricity consumption (CPUC Metrics 1f and 1h). Assuming 10 percent market implementation by the wastewater treatment sector, this could result in annual savings of 34 million kWh and $3.6 million in reduced operating costs.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$1,184,735
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$3,476,085	$2,419,427
Match Partner and Funding Split:	**Match Funding:**
Kennedy/Jenks Consultants: $38,400 (0.8 %) Aqua-Aerobic Systems, Inc.: $631,000 (13.2 %) Process Wastewater Technologies LLC: $552,300 (11.6 %) Linda County Water District: $29,640 (0.6 %) Water Environment Research Foundation: $25,000 (0.5 %) Regents of the University of California (University of California, Davis): $12,000 (0.3 %)	$1,288,340

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<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 5</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-076 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The Recipient submitted the Monitoring and Verification (M&V) report for the City of Lancaster demonstration site (100,000 gallon per day system) to the Energy Commission in November 2018. The report is under review but one of the findings indicate that a large primary filtration system capable of processing 15 million gallons per day will reduce secondary aeration power use by 32% (157 kW). The Recipient is analyzing 1.5 years of primary filtration operational data from the Linda County demonstration unit (1.5 million gallons per day system). Preliminary results indicate 25-30% reduction in aeration energy costs and 20-25% increase in secondary treatment capacity. The draft M&V report for Linda County and the City of Manteca (100,000 gallon per day system) is planned for late 2018. The draft final report for the project is also planned for late 2018.</td></tr>
</table>

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Project Name: Enable Standardized Vehicle-Grid Integration through Development of Universal Standard [EPC-14-077]	
Recipient/Contractor: Center for Sustainable Energy	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/30/2015 to 6/30/2018
Program Area and Strategic Objective: Applied Research and Development S9: Advance Technologies and Strategies That Optimize the Benefits of Plug in Electric Vehicles to the Electricity System	
Issue: California utilities are currently working to meet the State's Renewables Portfolio Standard of 33% by 2020, while simultaneously planning for the 1.5 million zero-emission vehicles that will be deployed by 2025, with over 130,000 plug-in vehicles (PEVs) sold since 2011. The State's vision to achieve cross-cutting benefits from these two separate yet interconnected efforts, however, requires new thinking on precisely how electric system operators can leverage and utilize PEVs as beneficial Distributed Energy Resources without compromising safety, data security, consumer simplicity or the mobility needs of the PEV owner.	
Project Description: The project was intended to design and develop a Demand Clearing House (DCH) to monitor published energy pricing from the California Independent System Operator's Fifteen-Minute Energy Market as well as load forecasts from San Diego Gas & Electric and other participating utilities through an Application Programming Interface translation from Open ADR 2.0b, a Demand Response protocol used by all California Investor Owned Utilities. The DCH would have then used algorithms that convert grid conditions into ISO/IEC 15118 "grid profiles," or Tariff Tables, which in turn would be communicated to 15118-capable charging stations and vehicles. A fully developed DCH would allow utilities to respond to supplemental energy market prices, proving a viable and scalable pathway toward using plug-in electric vehicles to manage variable grid conditions, solar oversupply, and other system wide challenges. This project was terminated early and will not complete.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Had the project been successful, this project would have advanced the adoption of an open protocol that enables large amounts of new, low cost flexible capacity on the grid. The open protocol could potentially minimize stranded investments in less cost effective forms of	

<table>
<tr><td colspan="4">flexible grid resources, maximize renewable and PEV integration, and promote a safer, more reliable low carbon future.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 [closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 4a, 4b</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$193,033</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,499,999</td><td colspan="2">EPIC Funds Spent:
$356,872</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
KnGrid: $31,312 (1.9 %)
Center for Sustainable Energy: $47,514 (2.9 %)
Broadband Telcom Power Inc.: $81,128 (4.9 %)
Energy Solutions: $2,520 (0.2 %)</td><td colspan="2">Match Funding:
$162,474</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 25 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-'Demand Clearing House' intellectual property delivered 'energy limits' based on inputs from a local grid operator. A building energy management (BEM) system was linked to a cluster of local charging stations. RWE's 'Demand Energy Management' system connected to the BEM system via SFTP and received a forecast of available power limits to the local charging stations.</td></tr>
</table>

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Update:

CSE was unsuccessful in completing this project to develop, test and demonstrate an open-source Demand Clearing House (DCH). CSE experienced numerous project delays due to the loss of a major subcontractor and subsequently their demonstration site. CSE and the Energy Commission determined that the project could not satisfactorily complete before the grant funds expired. These delays ultimately led to the proposed termination of this grant agreement. The only deliverable brought to completion was the DCH Server Specifications, which detail the design capabilities and functionality of the DCH. Work progressed on the DCH software, but was only completed up to 25%. The Server Specifications and "work in progress" software are available to the public for use and continued development. Energy Commission Audit staff concluded their audit and identified unresolved questioned costs.

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Project Name: Next-Generation Grid Communication for Residential PEVs [EPC-14-078]	
Recipient/Contractor: ChargePoint, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/30/2015 to 6/30/2018
Program Area and Strategic Objective: Applied Research and Development S9: Advance Technologies and Strategies That Optimize the Benefits of Plug in Electric Vehicles to the Electricity System	
Issue: Currently there are no adequate communication interfaces that allow communication between utilities, charging stations, and residential plug-in electric vehicle (PEV) customers. While there is some capability for aggregated commercial charging applications to provide grid stability, residential PEV participation in grid stabilization requires significantly more fine-grained data collected by advanced charging station-PEV communication protocols, coordination of charging at stations owned by different parties, and sensitivity to the driver's needs and preferences and a real-time understanding of each vehicle's state of charge or charge needed to make the next vehicle trip before departure.	
Project Description: The project develops communication interfaces between PEV customers and utilities using cloud-to-cloud OpenADR 2.0b communication with a vehicle charging network and will leverage emerging means for retrieving vehicle information via the ISO/IEC 15118 standard for consideration in the decision process. The communication will be able to gather customer data and receive signals from a third party (utility) for the purpose of optimizing PEV charging in a mutually beneficial manner to the customer and the utility. In addition to investigation and implementation of the ISO/IEC 15118 standard, the project will also investigate using control methods that do not require having vehicle charging information. This may be done through statistical estimation, rate of charge output from charging stations or driver opt-in based on maximum charge needed.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will lower or defer costs in upgrading local distribution infrastructure by providing a mechanism for demand management for local distribution networks, specifically managing	

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PEV charging with input from PEV customers, vehicles, and utility signals. The results from this project would allow the utility to optimize a residential customer's night time charging while still satisfying the driver mobility needs. The driver will have the same driving experience, generation and transmission resources can be optimized, and the grid costs and emissions can be reduced. ChargePoint determined that pilot participants experienced an average savings of 45 percent and there is potential for increased savings if the participants had increased visibility to monitor their vehicle's SOC, which is enabled by integrating the 15118 standard in the charging station and the PEV.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 [closed]

Applicable Metrics: CPUC Metrics- 1g, 1h, 2a, 3f, 4a, 5b

Lower Costs:

The pilot participants of this project realized an average of 45 percent energy savings on their vehicle charging when using the managed charging schedule.

Greater Reliability:

The methodology developed under this project will assess and test the real time potential for residential smart chargers to respond to utility signaling to support grid stabilization.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $139,418	
EPIC Funds Encumbered: $1,500,000		**EPIC Funds Spent:** $1,205,218	
Match Partner and Funding Split: ChargePoint, Inc.: $142,500 (8.7 %)		**Match Funding:** $142,500	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 25 out of 25 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 1

APPENDIX B:
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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-078 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project was completed in 2018. The final report is going through the Energy Commission's publication process. ChargePoint completed 15118 testing on the Daimler vehicle to send charging schedules to the vehicle and receive them back from the station. The three-month pilot program consisted of 1,005 charging events across 27 drivers in the San Diego Gas & Electric service territory who used the controlled charging schedule 58 percent of the time. Several participants indicated they were interested in using the controlled schedule more if the vehicle's state of charge (SOC) was more visible. Multiple drivers noted that they wished to limit their SOC at 80 percent to take advantage of the vehicle's regenerative braking capabilities or to protect their battery health. ChargePoint determined the pilot participants achieved a 45 percent average bill savings on their vehicle charging.

APPENDIX B:
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Project Name:

Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable More Residential Solar Energy

[EPC-14-079]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable

Issue:

One of the most prominent limiting factors for solar generation on California distribution systems occurs when multiple PV systems are installed behind a single distribution transformer. Limitations have already occurred in which consumers were not permitted to add solar, or inverters experienced shutdown due to local overvoltage conditions. It is not known whether multiple inverters can operate side-by-side in stable conditions when each one is performing smart-inverter functions. High PV penetration on the feeder and the voltage profile may be fine, but local over-voltage, variability, and equipment stress occurs on the customer side, limiting PV deployments and production.

Project Description:

The purpose of this project is to resolve the limiting conditions that occur on California distribution systems when many PV systems are installed behind a single residential distribution transformer by evaluating advanced inverter functionality with specific goal of enabling higher penetration of photovoltaic on the grid. The project is identifying, implementing, and testing (both in lab and field) optimal methods by which smart inverters can mitigate the issues that otherwise would limit local high penetrations of residential PV. The process will identify how California Rule 21 functions can be used and configured so that multiple smart inverters work in harmony and will also identify how other naturally-occurring consumer devices, such as electric vehicle chargers and other smart loads, can serve to further enable high-levels of solar PV.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

As the penetration of autonomous Rule 21 inverters increases, their interactions will grow in importance. This project will help provide a clear understanding of inverter characteristics and

of their potential interactions that may help preserve the stability and reliability of the grid, benefiting both consumers and operators. Consumers who invest in solar PV systems (and utilities that provide incentives or expect benefits from PV) wish to maximize the power they can realize from their system. Sharing excess PV generation with local loads may increase the utilization of such systems without negatively impacting the distribution grid.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Smart Inverter: D.14-12-035 (in R.11-09-011) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1b, 3d, 4a, 5a, 5b

Lower Costs:

The use of smart inverter functions, together with smart (PV-optimized) behavior of loads, can increase production (KWh) of residential systems by 15%. For an affected consumer on a constrained distribution circuit, this means more annual savings.

Greater Reliability:

The multi-inverter interaction testing and evaluation of smart inverter functions and smart management of consumer loads under this projects can minimize stress on grid equipment and will further improve reliability.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Grid Operations/Market Design	$400,537
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,705,478	$669,634
Match Partner and Funding Split:	**Match Funding:**
Electric Power Research Institute, Inc.: $149,452 (5.8 %) Underwriters Laboratories, Inc.: $78,174 (3.0 %) Southern California Edison Advanced Technology Organization: $260,000 (10.0 %) Intwine Connect: $107,758 (4.1 %) ClipperCreek, INC.: $66,480 (2.6 %) Sacramento Municipal Utility District: $156,000 (6.0 %) Pentair: $50,000 (1.9 %) Emerson Climate Technologies: $8,550 (0.3 %)	$891,414

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">A. O. Smith Corporate Technology Center: $15,000 (0.6 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 27 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project is currently in the laboratory testing phase. Work on test procedures has revealed inconsistencies among the Rule 21 specifications of the California utilities, leading to concerns about the proper configuration of currently installed inverters. Preliminary laboratory testing to characterize the advanced-function operation of the inverters has identified reliability and behavioral problems that are currently being investigated. New comprehensive test procedures have been developed by the project to investigate these issues and may also provide improved data for modeling advanced function inverters. While currently lacking quantifiable results from the sharing of excess PV production, planning calculations show that a 15% increase in an individual homeowner’s PV production would pay back the cost of the equipment required in about one year.</td></tr>
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APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Renewable Microgrid for a Medical Center

[EPC-14-080]

Recipient/Contractor:

Charge Bliss, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/17/2015 to 12/28/2018

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

California needs to make better use of locally available renewable energy to increase resiliency and address climate change impacts such as increased fires, severe storms, and heatwaves. Critical facilities, such as hospitals, are especially vulnerable to climate change impacts that disrupt the normal delivery of energy needed for their operation. Microgrids can help increase the resiliency of critical facilities such as hospitals through maximizing use of local renewable energy with energy storage.

Project Description:

This project is demonstrating the ability of a microgrid to support and sustain the functions of a healthcare facility and to overcome barriers to its deployment. The Charge Bliss team successfully designed, engineered, procured, constructed, and commissioned the microgrid systems at the Kaiser Permanente Hospital in Richmond, California. This included developing a next-generation microgrid controller capable of optimizing renewable energy generation, storage, and delivery and islanding and providing critical system support.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project demonstrates the value of a microgrid to healthcare facilities, including the reduction in energy costs, which are substantial for healthcare facilities, and the ability to support life and safety functions for three hours or longer to supplement existing backup generation and improve the energy reliability of hospitals in crisis situations. In collaboration with the governing agency Office of Statewide Health Planning and Development (OSHPD), the CEC and Charge Bliss are forging new methods and standards to support the resiliency and autonomy of critical healthcare facilities. This project helps inform deliberation of the requirement for healthcare facilities to have diesel backup.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a

Lower Costs:

This project expects to save $141,000 per year in direct energy costs for the site owner and create efficiencies in both usage and demand (automated demand response).

Environmental Benefits:

Use of the microgrid is expected to provide environmental benefits by reducing greenhouse gas emissions by 263 tons of carbon dioxide per year through the use of renewables.

Public Health:

The microgrid is designed to provide at least three hours of power during a utility outage for critical hospital facilities that are essential during mass casualties or illnesses in a region with an underserved population.

Assignment to Value Chain: Distribution		**Total Budgeted Project Admin and Overhead Costs:** $729,842	
EPIC Funds Encumbered: $4,776,171		**EPIC Funds Spent:** $4,135,837	
Match Partner and Funding Split: OSISoft, LLC: $1,119,560 (16.3 %) Kaiser Permanente Medical Center: $576,275 (8.4 %) Princeton Power Systems, Inc.: $400,000 (5.8 %)		**Match Funding:** $2,095,835	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 31 out of 40 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 4

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-080 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: In 2018, the Charge Bliss team continued to make adjustments to the microgrid controller software developed under the agreement to optimize the hospital's energy savings and to increase system run time to 98%. There has been a considerable amount of publicity and information shared with the public. Since the opening ceremony, the project has been highlighted in several articles from local media to industry magazines. The team has performed several presentations to interested groups including the California Society of Hospital Engineers (CSHE) and the Hospital Building Safety Board (HBSB), a division of California's Office of Statewide Health Planning & Development (OSHPD). The final report is in final review for publication and expected to be published in next couple of weeks.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption [EPC-14-081]

Recipient/Contractor:

PowWow Energy, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/15/2015 to 4/1/2018

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Annual electricity used to supply water to farms is estimated to be 10 TWh per year, or about 4% of California's total electricity usage. This usage increases significantly in drought years due to the need to pump water from increasingly deeper wells. In 2014, California growers extracted an estimated additional 5 million acre-feet of groundwater from aquifers to compensate for the lack of surface water and rain, resulting in an additional $454 million of energy costs for water pumping. This usage of groundwater is not sustainable, and resulted in the Governor signing a law (SB1168) to require growers to monitor groundwater extraction.

Project Description:

This project is demonstrating a software tool that links groundwater extraction with smart meter data to provide growers with automated information on energy and water consumption. This data is augmented by weather data and optional soil moisture data from local sensors to provide information to growers regarding irrigation needs. Use of the software program could help inform growers and reduce irrigation while maintaining or optimizing yield. This technology is being applied over 1,000 acres of farms owned by several growers of alfalfa, tomato, pistachios and almonds.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Reduced irrigation techniques have not been adopted by growers because of perceived risks associated with lower crop yield and quality, and lack of equipment and labor to measure water consumption. This project is developing a unique software tool for measuring groundwater extraction and water application, by leveraging smart meter data, as well as existing water data in the cloud and at the farm sites. The tool is unique because it uses smart meter data to measure water volumes from pumps without installing hardware devices on site. The tool also communicates with the farmer and irrigator to optimize crop yields and

water applications.

CPUC Proceedings addressing issues related to this EPIC project:

Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a, 4c

Lower Costs:

Supplying water for on-farm irrigation is an energy intensive task (especially for groundwater pumped from wells) that results in a large expense for growers. This technology could lower electricity costs associated with water pumping for farms. Additionally, optimized irrigation may reduce water use and could increase crop yield. For the affected demonstration farms, this could annually save approximately 400,000 kWh and 1,000 Acre-feet of water, or about $60,000 annually in energy cost.

Environmental Benefits:

Reduction in energy use will result in reductions in greenhouse gas emissions. Reduction in water use will lessen the impact on ground water pumping and issues associated with subsidence, especially in the Central Valley.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $332,162	
EPIC Funds Encumbered: $2,292,829		**EPIC Funds Spent:** $2,250,763	
Match Partner and Funding Split: UC Santa Barbara: $83,401 (2.9 %) UC Davis: $83,469 (3.0 %) PowWow Energy, Inc.: $368,698 (13.0 %)		**Match Funding:** $535,568	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-14-081 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project demonstrated on average 13% improvement in energy efficiency (energy savings for the same level of production performance) across a variety of crops and geographies. Project also achieved 9% in water use efficiency improvement (water savings for the same level of yield). If this innovation was implemented successfully across 20% of the farms in California, an estimated annual reduction of more than 66 GWh and 120,000 acre-feet in water use could be achieved. This project also demonstrated that smart meter data can be used to provide daily water records that help with water management on the farm. The project team continues to work with California electric utilities and host on farm workshops to engage new clients. This technology was used to document energy and water savings in the California Department of Food and Agriculture's State Water Efficiency and Enhancement Program.

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Project Name:

Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid

[EPC-14-082]

Recipient/Contractor:

Sierra Institute for Community and Environment

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	7/10/2015 to 12/31/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

Communities in the colder high Sierra regions of California often experience peak electrical loads during the winter due to a reliance on electric resistance heating, heat pumps with poor performance, and fuel switching from oil and propane to electricity when fossil fuel prices spike. These regions are also prone to catastrophic wildfires due to overstocked forests that exacerbate drought conditions. Electric and thermal energy from forest biomass clearing operations offer a unique opportunity to reduce peak loads using local renewable resources.

Project Description:

This project is deploying a biomass-fired combined heat and power system to provide heat and power to Plumas County health facilities. Biomass from local forest clearing operations will be used by a new biomass boiler to supply heat to an Organic Rankine Cycle (ORC) power unit. Waste heat from the ORC will be used as a heat source for heat pumps, improving their performance for the winter heating season.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will link emerging technology with new, innovative opportunities to advance renewable energy, distributed generation, and create clean energy jobs. The first-of-its-kind project combines a biomass-fired boiler with an Organic Rankine Cycle electric generator that diverts waste heat to source heat pumps supplying economical heat and power to a community-scale entity currently experiencing high energy costs. The project will help sustain a market for locally-sourced, sustainable forest biomass, providing jobs to the community and helping to reduce the risk of catastrophic wildfires that threaten transmission infrastructure and public safety. The project will serve as a template for other rural communities as how to combine emerging technologies in unique ways to address local energy needs using local

fuels and reducing their need for grid electricity and fossil fuels.

CPUC Proceedings addressing issues related to this EPIC project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005 Combined heat and power: D.10-12-035., R.08-06-024. [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a, 4b

Lower Costs:

By generating up to 35 kilowatts electricity and using 400 kilowatts (thermal) to supply heat pumps, the Plumas County Health and Human Services center will reduce its energy costs (electricity plus propane) by $50,000 per year.

Greater Reliability:

Electricity reliability will be enhanced by decreasing consumption of grid electricity during winter peak periods.

Increase Safety:

Safety will be improved by reducing both the risk and destructiveness of wildfires in forest communities by removing up to 815 tons of forest waste/biomass per year.

Environmental Benefits:

Burning biomass in a controlled setting rather than in the field will result in fewer pollutants (CO2, NOx, VOC and CO) being released into the environment.

Energy Security:

Energy security is enhanced by deploying 35 kilowatts of distributed electricity with waste heat utilization that will reduce load on the local grid and decrease peak demand by as much as 205 kilowatts.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$262,813
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$2,385,261	$2,208,089

APPENDIX B:
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<table>
<tr><td colspan="2">Match Partner and Funding Split:
Plumas County: $400,000 (13.4 %)
Sierra Institute for Community and Environment: $193,316 (6.5 %)</td><td colspan="2">Match Funding:
$593,316</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
16 out of 22 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Facility construction occurred in first and second quarters of 2018, and all equipment was installed and commissioning completed by June, 2018. A ribbon cutting ceremony was held on April 6 which included participants from the Sierra Institute, Plumas County, US Forest Service, community advocates, project developers and the Energy Commission. Over the summer and early fall of 2018, Sierra Institute secured a steady fuel supply and trained County technicians to operate the system. Currently the project is addressing minor shakedown issues and will commence regular data collection as soon as those are resolved.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

ABEC #4 Renewable Combined Heat and Power Project

[EPC-14-084]

Recipient/Contractor:

ABEC #4 LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

California has had limited success in the dairy biogas industry due to permitting obstacles and complexities, high environmental compliance costs, lack of long-term economical power purchase agreements, high financing risk and costs, and little commercialization of the industry. Further, dairy farmers typically are not experienced in building and operating digesters and generation systems. Combined Heat and Power (CHP) has the potential to increase dairy farm energy efficiency and reduce peak demand and dairy operation electricity costs. Projects demonstrating how dairies can benefit from CHP are critical to the success of future dairy digester-to-electricity projects.

Project Description:

The project uses biogas derived from on-site dairy manure to generate low-carbon, renewable electricity and achieve high overall efficiency by capturing waste heat from the power generation system, and uses it to drive an absorption chiller. The absorption chiller is designed to convert waste heat into chilling capacity, which will be used to chill milk produced by the dairy cows. New absorption chiller capacity directly offsets electricity consumption from existing electric chillers. Combining renewable generation with waste heat collection and cooling, the project increases energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project represents a significant advance in dairy energy management by combining renewable generation with waste heat collection and cooling to increase energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand. The project benefits include substantial reductions in greenhouse gas emissions, lower manure handling costs, and generation and distribution of technical and economic data on community scale power production.

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 3a, 4a, 4e

Lower Costs:

By advancing digester economics and design, through efficient manure management practices, the project will help lower dairy management and operation costs.

Environmental Benefits:

The double-lined lagoon enhances groundwater protection by minimizing leaching of manure into groundwater. Climate Trust estimates the Carbon Offsets that would likely be generated over the project's 10 year crediting period at 206,060 tonnes CO2e gross based on ARB's Livestock Protocol. The environmental benefits of this project include reduction of 11,012 metric tons of carbon dioxide (CO2) equivalent greenhouse gas, and holding exhaust emissions to under 6.4 ppm of nitrous oxides (NOx) and 57 ppm carbon monoxide (CO) which are both well under California Air Resources Board (CARB) limits of 11 ppm NOx and 210 ppm CO.

Consumer Appeal:

The project will improve odor control, through hydrogen sulfide removal, an issue important to the dairy employees and benefits the local community. Progress has been made in limiting hydrogen sulfide (H2S) emissions from a high of 5000 ppm to under 100 ppm while utilizing only the air injection system, and under 7 ppm with a final iron sponge scrubbing.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $32,107
EPIC Funds Encumbered: $3,000,000	**EPIC Funds Spent:** $2,673,175
Match Partner and Funding Split: ABEC #4 LLC CE&S Dairy Biogas: $4,983,619 (62.4 %)	**Match Funding:** $4,983,619
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	16 out of 23 bidders	Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Bioenergy Storage and Management System and Method.

Lagoon Digester with Flexible Volume Capability.

California Bioenergy LLC Lagoon Digester Systems.

Update:

The project broke ground in fall 2016 and construction is complete. A TAC was held in October, 2017 followed by a CPR in November. The project accepted a PG&E BioMAT Power Purchase Agreement and began testing in fourth quarter 2017 with full operation and data collection beginning in first quarter 2018. Monthly invoicing and progress reports are being submitted and the project is expected to complete as planned.

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Project Name:

Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System

[EPC-14-085]

Recipient/Contractor:

The Regents of the University of California, Davis

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2015 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

The intermittent nature of solar energy generation requires special attention when connecting to the grid. Critical issues include the grid instability of the distributed energy resources, and imbalance between energy demand and production, especially during periods of overgeneration. Although energy storage has the potential to serve multiple valuable functions in a microgrid setting, it is currently a very expensive resource because it is generally in the early stages of technology development. Renewable-based microgrids also require a reliable control system since they have insufficient inertia to dampen disturbances from distributed generation.

Project Description:

This project is demonstrating that the combination of advanced PV generation and an energy management system can reduce the community's average daily power and daily peak energy demand by more than 10%. The project includes a smart electrical energy storage system that integrates retired electric vehicle batteries. The generator and storage system are controlled by a commercial-grade microgrid controller, with the three levels of hierarchy. The demonstration site is located in the Robert Mondavi Institute at the UC Davis campus.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The combination of advanced PV and energy management systems will result in significant reduction in annual grid electricity consumption - estimated at over 80% or a cost savings of roughly $29,000 per year with associated greenhouse gas reductions of about 250 tons per year. Furthermore, the success of this project will provide follow-on benefits to California's large wine industry by proving that winemaking can be an environmentally-friendly process.

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CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed] Smart grid: R.08-12-009 [closed] Smart Inverter: D.14-12-035 (in R.11-09-011) Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1b, 1e, 1f, 1h, 2a, 3b, 4a

Lower Costs:

The project aims to reduce the high costs of energy storage by using second-life electric vehicle batteries and an advanced energy management system. The combination of advanced PV and energy management systems will result in significant reduction in annual grid electricity consumption - estimated at over 80%. This leads to economic and environmental benefits of annual electricity cost saving is over $29,000 per year which is equivalent to 57% reduction in electricity bill compared to without PV support.

Economic Development:

Proving the concept of a high-penetration renewable microgrid at the Robert Mondavi Institute is expected to lead to adoption of similar concepts at a number of vineyards and breweries across California.

Environmental Benefits:

The system will result in a substantial reduction in CO2 emission up to 253 tons per year. Furthermore, the success of this project will provide follow-on benefits to California's large wine industry by proving that winemaking can be an environmentally-friendly process.

Consumer Appeal:

California's wine and brewery market represents a significant market. The Robert Mondavi institute is generally considered a leader in this area, and if this concept is demonstrated successfully at this site, it is expected to be adopted elsewhere.

Energy Security:

This project will increase energy security on the UC Davis campus by enabling a microgrid with the potential to function during outages of the larger grid.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$124,883
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,238,491	$18,284

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:
Solexel: $12,000 (0.6 %)
UC Davis: $167,262 (8.8 %)
OSISoft, LLC: $479,467 (25.3 %)</td><td colspan="2">Match Funding:
$658,729</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
16 out of 22 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 5</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
In 2018, the project had delays in site construction design but continued work in parallel on equipment integration, controls, lab work and historical data collection. A no-cost extension was executed and the project is now back on track. The project team has now completed the construction and installation of the solar panels and battery energy storage system. The modified shipping container for battery energy storage system has been delivered and is fully integrated. The solar PV system has been commissioned and is operational. The research team is in the process of transporting and installing the battery system in the modified shipping container, which was slightly delayed due to campus shutdown due to poor air quality (smoke).</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability [EPC-14-086]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	8/1/2015 to 6/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Technologies and Strategies That Optimize the Benefits of Plug in Electric Vehicles to the Electricity System

Issue:

Several barriers must be overcome for plug-in electric vehicles (PEVs) to become viable distributed energy resources, including inconsistent data communication approaches among PEVs, a lack of situational awareness of the PEVs relative to grid state, fragmented technology and standards preventing interoperability and inclusion of vehicle-to-grid (V2G) resources into applicable distribution and independent system operator grid services related programs. In addition, there is limited availability of on- or off-vehicle V2G systems on scale from original equipment manufacturers (OEMs) because OEMs do not see their value to end customers.

Project Description:

The project developed an integrated vehicle-to-grid (V2G) system that was tested and demonstrated to be distribution-aware, self-regulating, interoperable, secure and open as well as scalable and flexible. These real-world test and demonstration results can provide confidence in the V2G systems that provide grid support functions and possibly influence investor owned utilities (IOUs) to add them to their Assembly Bill 2514 Storage Mandate compliance plans. The data gathered and analysis validated the cost effectiveness models through direct engagement with the IOUs' existing infrastructure and distribution networks, combined with simulated independent system operator interaction.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

PEVs with integrated V2G systems have the potential to simultaneously improve air quality, reduce vehicle operational costs and to reduce grid stress and increase grid reliability and stability. Monitoring at the transformer level with control of V2G provides enhanced local situational awareness and real-time responsiveness to distribution grid conditions. The developed management and monitoring system will have awareness of load, power,

temperature, current, voltage, frequency, and PEV customer constraints – information to be utilized to determine need for V2G resource. This approach provides a potentially significant solution for integration of a viable energy efficient energy storage technology into a decentralized grid structure, and with the ability to operate as a unified distributed energy resource aggregation system.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 [closed]

Applicable Metrics: CPUC Metrics- 1c, 1e, 2a, 3f

Lower Costs:

Analysis showed that PEVs can provide a net ratepayer benefit of ~$2,500 per vehicle and a statewide economic benefit of over $5,000 per vehicle. Using TOU rates to shift charging loads off-peak reduces distribution upgrade costs by over 60%. Further analysis of a dynamic hourly VGI rate shows that it can reduce present value of charging costs per vehicle under 40% RPS scenarios from around $1,400 to under $600 - a net benefit of $850 per PEV. The project team's value analysis showed $450-$1,850/year per PEV in avoided grid upgrade costs.

Greater Reliability:

Vehicle to grid technologies provide ancillary support to the grid during gaps in service and when addressing renewable generation intermittency. With increasing penetrations of PV, its marginal capacity value will decline from ~0.5 kW per kW of PV today to less than 0.1 kW. V2G capability of EVs can counteract this effect, providing a dispatchable capacity resource that can reliably reduce peak loads. In capacity constrained areas such as the LA basin, the local capacity value can be over $200/kW-Yr.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $666,988
EPIC Funds Encumbered: $1,499,977	**EPIC Funds Spent:** $977,726
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $795,754 (34.7 %)	**Match Funding:** $795,754
Leverage Contributors: N/A	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	25 out of 25 bidders	Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-086 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in 2018. The final report is undergoing the Energy Commission publication process. EPRI developed an end-to-end capable V2G system that demonstrated grid condition awareness in a safe and outage-immune method. Aerovironment and Kitu completed integration and assembly of J3072 and SEP 2.0b software into the 10 demonstration EVSEs. The research team developed the on-board V2G communication module for the PEV and demonstrated the functionality at UCSD. The value analysis showed a cumulative maximum benefit to the grid (net of cost increment) to range between $450-$1,850/year per vehicle in defrayed or deferred infrastructure upgrade costs, which is about five times more valuable than smart charging for similar grid service applications. The project partners, including the University of Delaware and U.S. DOE, are using the findings to further advance VGI research.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstration of Low-Cost Liquid Cooling Technology for Data Centers

[EPC-14-088]

Recipient/Contractor:

Asetek USA, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/13/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California is home to many data centers which consume a disproportionate amount of electricity in California. Approximately 40 percent of the electricity used in data centers is used for cooling. As traditional building efficiency improves, data centers continue to grow in size and power. Improving data center cooling efficiency represents one of the major energy efficiency measures for this sector.

Project Description:

This project is validating the performance, reliability, cost savings and payback of a data center efficiency technology that uses direct-to-chip liquid-cooling to cut data center cooling energy use. The technology is being demonstrated at two full scale data centers with the goal of minimal operational disruptions during installation. Energy consumption, load, reliability and server performance are being monitored. The results of the demonstrations, along with "lessons learned", will be made broadly available to the data center community and public-policy makers to stimulate adoption of this technology.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

If successful, the project will validate the performance, reliability, cost savings and payback of a data center efficiency technology that could reduce cooling costs while being able to be installed as a retrofit. This could lead to overcoming barriers to adoption by minimizing operational disruptions and costs compared with conventional installations and retrofits.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 4a
Lower Costs:
This technology could reduce electricity use and cost for cooling data centers. The lifecycle energy cost savings is projected to be approximately 30% compared to standard cooling technologies used for existing data centers.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$1,038,931</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$3,552,678</td><td colspan="2">EPIC Funds Spent:
$2,664,212</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Asetek USA, Inc.: $303,726 (6.0 %)
Lawrence Livermore National Laboratory: $1,216,012 (24.0 %)</td><td colspan="2">Match Funding:
$1,519,738</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-14-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Data collection for both Lawrence Livermore National Lab buildings have been completed. Analysis of the data and drafting of the final report is underway and the draft final report due to the Energy Commission by 12/31/18.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstration of Community Scale Generation System at the Chemehuevi Community Center [EPC-15-003]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Riverside Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	10/29/2015 to 3/30/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies

Issue:

California's electricity grid is undergoing significant changes. With major reductions in the cost of solar, customers are choosing distributed generation to meet their electricity needs. All these developments are crucial for California to meet its AB 32 goals, but they come with a number of challenges such as supply uncertainty, changing demand patterns, continual increase in energy consumption and ramping demands. New solutions will be required for the future electricity grid to continue providing reliable and cost effective electricity.

Project Description:

This project deploys and demonstrates a community energy generation system at the Chemehuevi Indian Tribe Community Center. The energy system incorporates two pre-commercial solar technologies with flow-battery energy storage integrated with energy management system. The integration of the energy management system components will reduce peak energy demand for the center by utilizing battery storage to shift building and community loads and provides an uninterruptable power for the center when it is used as an Emergency Response Center for the tribe.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will result in greater electricity reliability, lower electricity costs, reduced peak energy demand and avoidance of failures and outages by integrating a scalable system in both size and quantity and demonstrating the commercial feasibility to deploy many megawatt hours of dispatchable energy integrated in a photovoltaic/battery storage configuration.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project: Smart grid: R.08-12-009 [closed] Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003	
Applicable Metrics: CPUC Metrics- 1e, 1g, 1h, 2a, 3f, 4a, 5a Lower Costs: The system is designed to lower the kW demand by more than 10 percent of the daily average energy demand during peak times. This will result in a reduction of costs associated with procuring additional energy during periods of peak demand. Researchers estimate over $670,744 in energy savings from the solar PV system, $74,463 from energy storage revenue streams, and $38,910 in preventing costs due to sustained interruptions over a 20-year period. Greater Reliability: Greater electricity reliability is achieved by managing energy use and local generation supported by PV generation and battery storage in daily energy use profiles. This will help reduce failures and outages associated with demand response. Environmental Benefits: Researchers estimate a carbon reduction of 1,038 tons over the life of the project.	
Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $525,157
EPIC Funds Encumbered: $2,588,906	**EPIC Funds Spent:** $1,412,506
Match Partner and Funding Split: The Regents of the University of California - Riverside: $77,451 (2.4 %) OSISoft, LLC: $479,467 (14.5 %) Primus Power: $21,780 (0.7 %) Chemehuevi Indian Tribe: $91,000 (2.8 %) Solexel: $12,000 (0.4 %) SunPower Corporation, Systems: $25,000 (0.8 %)	**Match Funding:** $706,698
Leverage Contributors: N/A	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	16 out of 22 bidders	Group 2: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has deployed an energy generation system at the Chemehuevi Indian Tribe Community Center. The system incorporates a 90.36 kW solar PV system and a 25 kW/125 kW-hour (kWh) flow-battery energy storage system integrated with energy management system to offset the center energy consumption of 102,000 kWh/year and manage peak energy demand by utilizing battery storage to shift building and community loads and provides an uninterruptable power for the center when it is used as an Emergency Response Center for the tribe. As of 11/15/2018 the system is operational and connected to grid after signing an interconnection agreement with SCE. The next step is to evaluate the most favorable rate schedule for the community center and to go through the process to participate in a demand response program. A ribbon-cutting ceremony for the project is anticipated in January 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand

[EPC-15-004]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	8/3/2015 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Cooling and heating buildings contribute to a large portion of the electricity bills for California ratepayers. Traditional heating, ventilating and air conditioning (HVAC) systems waste energy. Innovations in HVAC systems, such as variable refrigerant flow and advanced indirect evaporative cooling systems are well suited for California climates. However, the full potential of these innovations has not been realized.

Project Description:

This project is developing and demonstrating a Climate Appropriate Air Conditioning system for commercial buildings that optimizes occupant comfort and can reduce energy use and peak demand. The project will apply a combination of Variable Refrigerant Flow (VRF) technology with Indirect Evaporative Cooling (IEC) integrated and operationally optimized through the building control system. The project will also investigate alternative non- Ozone Depleting Potential (ODP) or low global warming (GWP)refrigerants and HVAC system designs that could enable their usage in commercial buildings. This project will benefit small and medium commercial buildings, such as retail stores, offices buildings and food service and could be implemented in existing and new commercial buildings through direct replacement of rooftop packaged air conditioners. It is estimated that the HVAC systems for these sectors use 7,000 GWh and contributes 5 GW of peak demand.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The technology advancement is the intelligent HVAC controller that processes signals from building sensors and system feed-back to maximize system efficiency while also synchronizing operation of the VRF and IEC to reduce energy use and peak energy demand and maximize occupant comfort. The innovative control system utilizes cloud based

<table>
<tr><td colspan="4">optimization using weather, grid conditions and occupancy (CO2) as inputs to optimally operate a VRF and the IEC system to reduce both energy and water use. The IEC will be set up as a dedicated outdoor air system and incorporate variable speed blower and heat recovery ventilation. These subsystems will also be intelligently controlled by the building controller. This project will also evaluate and provide system designs that use alternative refrigerants that have zero ODP or low GWP.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 4a
Lower Costs:
This project could reduce electricity use for HVAC systems up to 40 percent. This could mean lower energy costs for commercial building owners or occupants that pay utility bills.

Environmental Benefits:
This project could reduce electricity use in HVAC systems and identify potential alternative refrigerants that could reduce greenhouse gas emissions.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$1,088,673</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,834,721</td><td colspan="2">EPIC Funds Spent:
$918,818</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Electric Power Research Institute, Inc.: $440,509 (13.4 %)</td><td colspan="2">Match Funding:
$440,509</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 9</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: EPRI has finalized the test sites for this project and they include: Western Cooling Efficiency Center in Davis, two fast food restaurants in Aliso Viejo and an office building in San Diego. The Davis site will add indirect evaporative cooling and the San Diego site has just added a new variable refrigerant flow (VRF) loop to work in conjunction with the current evaporative cooling. The Aliso Viejo site will add both evaporative cooling and a variable refrigerant loop. The new VRF in San Diego has been undergoing commissioning. The recipient is collecting data at the Davis and Aliso Viejo sites to establish baseline conditions prior to equipment installation. Approximately 12 months of monitoring and verification is planned. The alternative refrigerant work is continuing and testing is underway for a new propane, CO2 and ammonia units along with work on the model and control system.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Potential Impacts and Adaptation Options for the Electricity System from Sea Level Rise in the San Diego Area.

[EPC-15-005]

Recipient/Contractor:

ICF Incorporated, L.L.C.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	12/10/2015 to 5/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Sea-level rise (SLR) presents a critical threat to California's low-lying coastal areas and the energy infrastructure located there. The reliability of California's electricity service could be threatened by either permanent inundation from SLR or temporary coastal flooding events that cause disruptions to generation, transmission, and distribution.

Project Description:

The project evaluated SLR vulnerability and adaptation options in the SDG&E service area at a level of detail appropriate for informing electricity sector policy and planning. ICF International partnered with SDG&E to conduct a detailed and robust sea level rise vulnerability assessment and to identify and evaluate appropriate adaptation measures. This project identified adaptation measures for the electrical system that are actionable and aligned with existing policies, based on a comprehensive understanding of the vulnerabilities of specific assets, how these combine at a system level, and significant feedback from the utilities. The results were formed with significant input from the IOU to ensure the adaptation measures are actionable.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Detailed SLR inundation modeling that builds on previous studies is used to identify the SDG&E infrastructure that will be exposed to coastal flooding and assess how the electricity system could be affected. Impacts of coastal inundation and possible adaptation measures are determined using literature reviews, interviews with key experts, modeling, and workshop elicitation. Potential direct and indirect impacts are used at an asset-by-asset level and through system-wide assessment, including power flow modeling to support a "value of lost load" analysis. This level of information was not previously available to SDG&E for use in its planning.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 5a, 5d
Greater Reliability:
This study will improve electricity reliability by decreasing the chances of SLR damage to grid infrastructure. The project identified the greatest potential direct physical impacts to assets are damage to substations in the Mission and San Diego bay areas. Service disruption could result in costs to customers ranging from $1.2 to $25 billion, under a worst-case end-of-century storm scenario assuming no adaptation actions are taken. The flexible adaptation pathways developed by the research team could provide SDG&E with a practical approach to manage uncertainty and reduce service disruptions.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$240,425</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$499,929</td><td colspan="2">EPIC Funds Spent:
$478,037</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
San Diego Gas & Electric Company: $166,200 (25.0 %)</td><td colspan="2">Match Funding:
$166,200</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
12 out of 13 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

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Update:

Working closely with SDG&E, the research team first collected information on specific infrastructure assets and operations, and identified potential climate impacts. The climate impact vulnerabilities of the electricity system were then identified and discussed with the utilities. A matrix of assets and electricity service categories was developed in 2016. The research team collected information on electricity system adaptation measures and presented them to the utilities at a series of workshops to obtain feedback in summer and fall of 2017. The utilities are already using some of the results from this study for adaptation planning.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Modeling the Impact of Wildfires on California's Transmission and Distribution Grid

[EPC-15-006]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	2/12/2016 to 6/1/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Climate projections indicate longer, warmer dry seasons in California, thus increasing the risk of large wildfires. Previous research funded by the Energy Commission established that some climate change scenarios could cause a substantial increase in exposure of major existing transmission lines to wildfire, but the vulnerability of distribution circuits has yet to be investigated. Research is needed to extend this previous assessment of vulnerability of the transmission system in California to include the distribution system.

Project Description:

This study advanced scientific knowledge by combining and enhancing several state-of-the-art models to produce the most detailed analysis to-date of California's current and future electric transmission and distribution grid and fire risk under alternative conditions of climate change and grid evolution.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project identified segments of the electric grid that are now or will become most vulnerable to increasing wildfire risk. This knowledge allows operators to improve maintenance of grid reliability and safety while adapting to the challenge of changing climate. Researchers applied a unique methodology to measure wildfire risk, allowing them to relate an evolving wildfire probability over time with an evolving electricity grid. The methodology analyzed the cost benefits of grid adaptations for minimizing the risk associated with future wildfires.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 2a, 5a, 5d

Lower Costs:

The study modeled the cost benefits of maintaining a reliable electricity supply in the face of increased wildfire risk. Over the 2000-2016 period, wildfire damages to the transmission and distribution system in selected areas exceeded $700 million.

Greater Reliability:

The study was designed to increase reliability and the capacity of the electricity system to respond to increasing climate change-related wildfire risk. The project explored adaptation strategies for minimizing impacts of wildfire, including avoiding high fire risk areas for new transmission system paths and undergrounding selected transmission paths. Adaptation strategies for the distribution grid included compact urban development to minimize the amount of urban fringe exposed to wildfire.

Increase Safety:

Greater ratepayer safety follows from improved electricity system reliability, because that reduces the potential hazards associated with power outages, such as public health and operations of critical facilities.

Assignment to Value Chain: Distribution		**Total Budgeted Project Admin and Overhead Costs:** $169,786	
EPIC Funds Encumbered: $500,000		**EPIC Funds Spent:** $500,000	
Match Partner and Funding Split: University of Hawaii at Manoa: $17,157 (3.3 %)		**Match Funding:** $17,157	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 13 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project was completed in 2018. The final report, included in California's Fourth Climate Change Assessment, is available online at http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-002.pdf. The researchers obtained the maps of future burned area being used for California's Fourth Climate Change Assessment as the basis for their study of future risk to the transmission and distribution system. They mapped current and future exposure of operationally significant segments of transmission paths to wildfire. They used land use projections of urban expansion as a proxy for the extension of the distribution grid. Then they used the PLEXOS model to estimate the cost of fire-caused outages with and without wildfire forecasts, such as the change in generation costs as other power plants are dispatched to replace the stranded generators during the outage.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat

[EPC-15-007]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/12/2016 to 9/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Because Los Angeles County is such a geographically diverse region, the impacts of climate change will be experienced differently across neighborhoods. Understanding the localized effects of climate change and the impacts on communities has been difficult to assess. Research predicts the Los Angeles region will be warmer by 3-5 degrees F annually by mid-century, and will have an increase in the number of "extreme heat days" varying regionally, with some cities experiencing up to 5-6 times their current levels. What is still unknown however, is how and where these increases in temperature will impact the electric grid.

Project Description:

This project developed a sophisticated description of future electric grid demand, response, and vulnerability due to increased (and prolonged) heat events in Southern California Edison territory under current and future climate scenarios. It will enable innovative grid management and operation strategies and will identify adaptation guidance. Researchers provided the information to local governments, regional and state agencies, utilities, and the general public in tangible, easy-to-understand policy briefs to enhance local and state capacity to respond to potential disruptions in distribution due to climate change.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project integrated a set of models in a novel way to link new results on extreme heat events in Los Angeles County with electricity demand projections that respond to these events and then to model how these climate impacts would affect the vulnerability of electricity supply and the transmission and distribution networks. Doing so created a greater level of understanding on where the grid is most vulnerable, which neighborhoods each circuit serves, and what types of adaptation measures may need to be taken by the utility as well as state, regional, and local actors. The project can equally help guide investments in

distributed generation that could alleviate pressure on the conventional electricity generation system.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 1e, 2a, 5a, 5d

Lower Costs:

This study could lead to lowered costs for ratepayers by providing utilities and policymakers with new information relevant to where and how to prioritize capital investments in the grid. Results from this project will inform where and how implementation of distributed generation should be prioritized to meet future demand, mitigate risk of component failures and outages, and transition to a more resilient and cost-effective grid.

Greater Reliability:

This project identified conditions under which grid systems may be vulnerable to capacity shortages and outages due to extreme heat, as well as mitigation options that could prevent such outages. These vulnerabilities were identified for specific census block groups and components within the region. Identifying specific vulnerabilities enables improvements in risk management and long-term planning processes to ensure resource adequacy, demand-side management options, and delivery system capabilities that provide uninterrupted power services. An unanticipated finding revealed the greater energy efficiency of common wall residences and provide greater reliability through reducing demand.

Increase Safety:

Proactive prevention of outages improves safety directly by mitigating potential for explosive fire hazards in oil-based transformers due to power overloading, and indirectly by mitigating potential for major interruptions in other services that depend on electricity. As this analysis was mapped out geographically, it facilitates the identification of and planning for those ratepayer communities at greatest risk.

Public Health:

Human health is vulnerable to extreme heat, and if there are multiple electric power outages during a heat wave, then people could be stranded and at risk of severe medical incidence, e.g. heat exhaustion or death. Proactively identifying risks of power outages during extreme heat events through this project enables grid operators to better maintain reliable power services for electric cooling, transportation, and water, and prevent such risks to public health.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Assignment to Value Chain: Distribution		**Total Budgeted Project Admin and Overhead Costs:** $84,000	
EPIC Funds Encumbered: $500,000		**EPIC Funds Spent:** $357,753	
Match Partner and Funding Split: The Regents of the University of California, Los Angeles: $168,753 (24.7 %) County of Los Angeles: $15,000 (2.2 %)		**Match Funding:** $183,753	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 13 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: This project was completed in 2018. The final report is available online as part of California's Fourth Climate Change Assessment at http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-013.pdf. The research team projected peak demand for Los Angeles County due to climate change. An 8-11% increase of substation capacity, DER, or peak load shifting will be needed throughout Los Angeles County to keep substation load factors at or below 1 during the worst-case heat waves by 2060. The team conducted an extensive outreach effort to inform utilities and others. The team is briefing CPUC for R.18-04-019 on strategies and guidance for climate change adaptation. Three journal papers will be published. The South Bay Cities Council of Governments intends to use the electricity demand and grid vulnerability projections in developing their climate action plan.			

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt [EPC-15-008]	
Recipient/Contractor: The Regents of the University of California, Berkeley	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 11/16/2015 to 6/28/2019
Program Area and Strategic Objective: Applied Research and Development S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts	
Issue: California's electricity system is vulnerable to a variety of weather- and climate-related events, and stakeholders involved in electricity system management, operations, and planning must have timely access to relevant, best available, peer-reviewed data in a form that is easy to understand and useful for timely decision-support. As part of California's Fourth Climate Change Assessment, a suite of energy sector research projects is probing vulnerabilities and resilience options for the electricity system. Cal-Adapt 2.0, developed and launched under EPIC funds, is the platform through which underlying climate scenarios are rendered accessible to energy sector stakeholders.	
Project Description: This project develops a suite of analytical and outreach approaches to provide electricity system stakeholders with actionable data pertaining to local climate risks. The project is organized around three imperatives. The first is developing interactive, visually compelling, and useful web-based visualization applications depicting climate-related risks to the electricity infrastructure. The second is to build focused toolsets to support planning to protect energy infrastructure. Finally, the project includes outreach and training with energy stakeholders, climate practitioners, planners, managers, educators and ratepayers in the state through targeted workshops, webinars, and presentations. As articulated by electricity sector IOUs in the 2017 IEPR Adaptation Workshop, Cal-Adapt 2.0 is an instrumental tool for developing and implementing locally appropriate adaptation options in the electricity sector.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Cal-Adapt provides integrated tools that directly support electricity sector decision making with regard to infrastructure planning and management. Moreover, Cal-Adapt 2.0 coheres with the Governor's Office of Planning and Research's adaptation guidelines and is a key resource for accessing the data prescribed by those guidelines. Use of Cal-Adapt 2.0 to plan for climate resilience contributes multiple benefits to California's electricity ratepayers by helping to stabilize the grid, improve service reliability, and reduce financial losses associated with power outages.

CPUC Proceedings addressing issues related to this EPIC project:

Applicable Metrics: CPUC Metrics- 5a, 5d

Greater Reliability:

Integrated planning supported by this project will help improve service reliability and reduce financial losses associated with power outages. For example, as discussed at the 2017 IEPR Adaptation Workshop, SDG&E is using Cal-Adapt to support a review of transmission line design standards.

Energy Security:

Integrated planning supported by this project will help stabilize the grid and reduce system outages.

Assignment to Value Chain: Grid Operations/Market Design		**Total Budgeted Project Admin and Overhead Costs:** $74,324	
EPIC Funds Encumbered: $400,000		**EPIC Funds Spent:** $398,891	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 12 out of 13 bidders	**Rank of Selected Applicant/ Bidder:** Group 4: Ranked # 1

APPENDIX B:
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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research team released version 2.0 of Cal-Adapt, which includes more powerful visualization tools, new datasets, improved access to data, and a public platform for development of custom tools. New data include higher-resolution projections of temperature and precipitation designed to capture extremes as well as a hydrodynamical dataset for exploring potential inundation associated with sea level rise along the entire California coast, and the Bay Area and Sacramento/San Joaquin Delta. The Cal-Adapt team also developed several aggregation and data download options, as requested by the Technical Advisory Committee, which includes utilities and CAISO. Pursuant to a User Needs Assessment Workshop to capture electricity sector needs, Cal-Adapt launched a stream flow tool and improved existing tools (e.g., "quick stats" and historical modeled data download) to support IOU analyses.

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Project Name:

Workforce Instruction for Standards and Efficiency (WISE)

[EPC-15-009]

Recipient/Contractor:

California Homebuilding Foundation (CHF)

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	11/30/2015 to 3/31/2020

Program Area and Strategic Objective:

Market Facilitation

S17: Strengthen the Clean Energy Workforce by Creating Tools and Resources that Connect the Clean Energy Industry to the Labor Market

Issue:

California's homebuilding market emerged from the recession to find that many skilled tradespeople have permanently left the residential construction market. Meanwhile, techniques for constructing high performance attics, walls, and roof assemblies that were once considered "advanced practices" employed by few builders are now code requirements for new residential construction. The lack of skilled labor, coupled with increased demand for high-performance insulation techniques, could disrupt the rate of adoption of these measures or lead to poor installation of them. This may result in lower than expected energy savings and construction defects that impose safety risks.

Project Description:

This project is providing education, outreach, and resources for California's new residential building industry on high performance attics (HPAs) and high performance walls (HPWs), two new requirements in the state's 2016 Building Energy Efficiency Standards. The project helps the new residential building industry to better understand new requirements and options for compliance, and provides them with technical support to enable the transition to the new requirements. Additionally, the project team provides on-the-job training to homebuilders, installing trades, subcontractors, and field crews, on the proper installation of insulation, and on changes to other building systems that will be necessary to meet the new requirements.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The California Energy Code now requires new homes to be constructed with HPAs/HPWs, to meet energy efficiency standards. This project helps overcome market barriers for HPAs/HPWs by providing the construction industry with access to on-the-job training and tools on the best available technologies, techniques, and practices for complying with the new requirements.

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CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1c, 1e, 1f, 1h, 2a, 3c, 4a, 4b

Lower Costs:

As builders become more familiar with proper installation practices and products are more widely deployed, the costs for installing HPAs and HPWs will be reduced. Additionally, proper installation will lead to energy savings, further reducing costs for ratepayers.

Increase Safety:

Training will improve safety by ensuring builders follow manufacturers' code-compliant installation guidelines to reduce the risk of construction and structural defects.

Public Health:

Supplemental ventilation training will ensure indoor air quality is unaffected or improved by changes to construction practices.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$1,667,291
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$4,431,918	$2,292,572
Match Partner and Funding Split:	**Match Funding:**
APA - Engineered Wood Association: $473,710 (2.4 %) BASF: $990,000 (4.9 %) Bayer Material Science: $1,230,290 (6.1 %) California Building Industry Association (CBIA): $58,110 (0.3 %) Ensoltis Green Hybrid Roofing: $631,600 (3.1 %) KB Home: $3,043,501 (15.1 %) Owens Corning: $2,327,444 (11.6 %) Panasonic Eco Solutions North America: $265,200 (1.3 %) PCBC: $151,200 (0.8 %) QC Manufacturing: $335,220 (1.7 %) Shea Homes: $2,248,622 (11.2 %)	$15,685,075

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<table>
<tr><td colspan="2">SIPA - Structural Insulated Panel Association: $303,000 (1.5 %)
SPFA - Spray Polyurethane Foam Alliance: $239,000 (1.2 %)
Taylor Morrison Homes of California, LLC: $1,929,494 (9.6 %)
Tru Team of California: $1,008,684 (5.0 %)
ConSol: $450,000 (2.2 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
4 out of 4 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The team provided training and technical support to the building industry on HPA/HPW practices, including impacts of the 2019 Title 24 requirements on code compliance. This included a two-day classroom and hands-on training at a Passive House (built for high energy efficiency), educating industry participants on compliance options and proper installation techniques. Training modules were developed for a new online certification through High Performance Insulation Professionals. Informational materials and success stories were also updated on the project website: www.wisewarehouse.org. Finally, a new HPA/HPW curriculum was developed for the Building Industry Technology Academy, a statewide high school program that incorporated it into their annual build challenge for Southern California. The team will continue offering training and scale-up measurement and verification activities in 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Expanding Energy-Related Career Pathways in the Electrical Industry: Increasing Workforce Development Opportunities in Disadvantaged Communities and Delivering Training on Automated Demand Response Communication Equipment to Inside Wireman Apprentices

[EPC-15-010]

Recipient/Contractor:

Center for Sustainable Energy

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	12/8/2015 to 3/31/2020

Program Area and Strategic Objective:

Market Facilitation

S17: Strengthen the Clean Energy Workforce by Creating Tools and Resources that Connect the Clean Energy Industry to the Labor Market

Issue:

Automated demand response (AutoDR) equipment and communications standards have evolved significantly over the past decade. However, these advances and standards have not been adequately translated into training programs to help facilitate the widespread deployment of AutoDR communication equipment. Lack of an adequately trained workforce could limit the benefits provided by demand response to electric customers and the larger grid.

Project Description:

The project is recruiting workers from disadvantaged communities into apprenticeship programs at California Joint Apprentice Training Centers (JATCs), providing them with comprehensive classroom and on-the-job training on the installation and maintenance of AutoDR communications equipment. By addressing the acute skills gap by producing a workforce qualified to install and maintain cutting-edge AutoDR communications equipment, the project is enabling demand response to be deployed in the market at scale.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The California Energy Code was updated in 2013 to require lighting systems in large buildings to be capable of receiving and automatically responding to at least one standards-based messaging protocol which enables demand response. This project is helping ensure a workforce that is trained in the proper installation and maintenance of AutoDR communications equipment exists to meet California Energy Code requirements for commercial buildings.

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CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1e, 1g, 1h, 2a, 3f

Lower Costs:

Proper installation of AutoDR communications equipment will facilitate greater levels of demand response by reducing the transaction costs for participating customers.

Greater Reliability:

Compared to manual response, properly installed AutoDR communications equipment increases customer response to utility or system operator messages about a demand response event.

Economic Development:

Training on the proper installation and maintenance of AutoDR communications can provide increased employment opportunities for workers in disadvantaged communities.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $863,874
EPIC Funds Encumbered: $4,476,189	**EPIC Funds Spent:** $1,719,852
Match Partner and Funding Split: California LMCC IBEW-NECA: $16,165,080 (78.3 %)	**Match Funding:** $16,165,080
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 4 out of 4 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: In 2018, all of the JATCs continued their online courses, and the Sacramento, San Leandro, and Orange County JATCs began in-person courses. Meanwhile, the Los Angeles JATC prepared the lab space for in-person courses. CSE refined course materials per student feedback, and continued developing and revising outreach materials for contractors and apprentices. Through November 2018, a total of 588 students have completed the course either in-person or online, and enrollment for 2019 continues to grow. CSE also worked with local organizations in DACs to recruit for the training program. Additionally, the team finalized a Measurement and Verification plan and began implementation to evaluate the success of the project. Learn more about this project at: http://energycenter.org/demand-response

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Improving Membrane Treatment Energy Efficiency through Monitoring the Removal of Colloidal Particle Foulants

[EPC-15-012]

Recipient/Contractor:

Kennedy/Jenks Consultants, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/30/2016 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Membrane treatment processes are highly energy intensive due to the fouling of the membranes over time. The high energy demand of low pressure membranes is caused by the accumulation of colloidal particles in the feedwater inside the membrane pores which increases the transmembrane pressure. There are no techniques to measure the levels of colloidal particles directly in wastewater, and minimize their deposition in membrane pores. As a result, many utilities do not pretreat the entering wastewater prior to membrane treatment. This results in membrane fouling and high energy use.

Project Description:

The project is demonstrating an online monitoring technology for wastewater treatment plants to directly measure colloidal particle concentrations in order to lower membrane fouling and reduce energy use and maintenance costs. Direct detection of colloidal particles will help determine the optimal pretreatment needed to minimize deposition of colloidal particles in membrane pores.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Nationwide there are over 100 microfiltration/ultrafiltration treatment plants and there are over 100 reverse osmosis facilities in California using membranes. Membrane treatment for wastewater treatment is very energy intensive due to fouling of membranes over time. This project could overcome the barriers to use of membrane treatment by demonstrating a technology that can detect colloidal particles in membrane feed water. This can facilitate an optimal pretreatment process for their removal and reduce membrane fouling and energy costs.

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CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 4c

Lower Costs:

The project could reduce the frequency of cleaning and membrane replacement, energy use, and wastewater treatment plant operating costs by reducing the build-up in membrane pores and removing colloidal particles in the feed water during the pre-treatment phase. Assuming 50 percent improvement in microfiltration membrane efficiency, 20 percent improvement in reverse osmosis efficiency, and a 50 percent market penetration, the annual energy cost savings is estimated at $5 million.

Economic Development:

If the project is successful, Malvern Instruments, the owner of the technology will directly market this technology to water clients throughout California and will extend worldwide. Malvern is located in the United Kingdom. The technology could lower the overall cost of water reclamation due to improvement in energy efficiency, reduction in membrane cleaning frequency, and reduction in membrane replacement frequency. Therefore, this will help to provide a reliable local source of water.

Environmental Benefits:

By reducing energy use, the project has the potential of reducing greenhouse gas emissions by over 35,000 metric tons assuming 50 percent market penetration, 50 percent improvements in microfiltration membrane efficiency and 20 percent improvement in reverse osmosis efficiency.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $429,784
EPIC Funds Encumbered: $1,167,034	**EPIC Funds Spent:** $622,040
Match Partner and Funding Split: Orange County Water District: $60,000 (4.0 %) West Basin Municipal Water District: $50,000 (3.3 %) Evoqua Water Technologies: $126,000 (8.4 %) Malvern: $100,000 (6.7 %)	**Match Funding:** $336,000

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<table>
<tr><td colspan="2">Leverage Contributors:

N/A</td><td colspan="2">Leveraged Funds:

$0</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders</td><td>Rank of Selected Applicant/ Bidder:

Ranked # 9</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:

The contractor has completed demonstration of this technology at two sites (Orange County Water District and West Basin Municipal Water District). Southern California Edison staff conducted the measurement and verification testing. Testing over multiple clean-in-place (CIP) cycles demonstrated that, the transmembrane pressure (TMP), and hence, the energy consumption, in the pilot retrofitted with the proposed technology was 70% lower than the control pilot unit. Tests were also performed to identify potential unintended consequence of accidental release of high dose of coagulants during membrane treatment. These tests indicated that, addition of coagulant did not increase the levels of aluminum, a key constituent of the coagulant, in the treated water. The contractor will send the draft final report by January 31, 2019.</td></tr>
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Project Name:

Open Source Platform for Plug-in Electric Vehicle Smart Charging in California

[EPC-15-013]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	2/1/2016 to 1/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Technologies and Strategies That Optimize the Benefits of Plug in Electric Vehicles to the Electricity System

Issue:

Plug-in electric vehicles (PEVs) represent a rapidly proliferating new vehicle technology and source of utility grid load. Currently only pilot concepts exist for actively managing PEV charge control for the benefit of California's grid and ratepayers. Meanwhile California's electrical grid is evolving to rely more on intermittent renewable power sources, with different "grid acceptance" issues than more traditional generation sources, driven by the state Renewable Portfolio Standard (RPS), creating a unique opportunity for PEV charging and the "greening of the grid" to go hand-in-hand.

Project Description:

The project develops a one-way charging concept for PEVs that maximizes accommodation of intermittent renewable generation and minimizes impacts to the distribution grid. The project focuses on controlling the charging of PEVs in residential and small commercial settings using a novel and flexible open-source, open-software architecture charge communication and control platform. This software-based platform will be embedded in the context of overall utility and residential/business electrical and building automation systems, lending itself to potential broad implementation by commercial interests due to its flexible architecture and "agnostic" approach to communications standards. Control strategies and applications will be guided by an assessment of user needs and grid operation and ratepayer benefits, and the potential for one-way PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project focuses on controlling the charging of plug-in electric vehicles PEVs at residential and small commercial settings using a novel and flexible open-source, open-architecture charge communication and control platform. This XBOS-V platform is embedded

in the context of overall utility and residential/business electrical and building automation systems, lending itself to potential broad implementation by commercial interests.

This integrated project also focuses on the development of the open-source platform including assessment of user needs and grid operation and ratepayer benefits, grid security considerations, and the potential for PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid. The platform is flexible to adoption/inclusion of several communication protocols.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 [closed]

Applicable Metrics: CPUC Metrics- 2a, 3h, 4a

Lower Costs:

This project is estimated to result in $176 million per year reduction in electricity costs for ratepayers in 2024 from lower electric distribution system upgrade and operating costs, increased electric distribution system energy efficiency, increased PEV charging energy efficiency, and lower electricity generation costs.

Greater Reliability:

This project is expected to increase reliability of the electric distribution grid, reducing frequency of outages by 25% in residential areas. Coordinated charging of PEVs in distribution networks could reduce impacts from sudden surges in charging (e.g., PEV owners in large groups set the timing of the charge to coincide with reductions in TOU rates after the evening peak). By coordinating the charge more carefully across utility distribution level nodes, these grid impacts can be greatly minimized based on initial project findings. Managed charging also has the potential to curtail about 500 GWh of renewable overgeneration.

Environmental Benefits:

This project could reduce carbon dioxide emissions of 340,000 metric tons per year in 2024 from increased electric distribution system energy efficiency, increased PEV charging efficiency, increased fraction of intermittent operationally GHG-free renewable electricity generation, and the decreased need for GHG-intensive supplemental peaking generation.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$549,477

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<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,500,000</td><td colspan="2">EPIC Funds Spent:
$918,169</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
BMW of North America: $90,000 (5.7 %)</td><td colspan="2">Match Funding:
$90,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 25 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project team is refining the software development strategy, developing functional specifications, and developing the physical test-bed. All the test-bed technical elements were installed and integrated into the XBOS platform with ongoing physical testing. The devices include the electricity panel energy monitoring device, the smart PEV charger, baseboard thermostat control units, smart lighting units, and additional Wi-Fi enabled plug-load controllers. The project team is continuing work on algorithms to manage PEV charging to ease congestion at the distribution level through localized control and charge management and address the potential larger grid values of VGI. The ongoing extend grid conditions and VGI analyses using PEV adoption scenarios through 2030 includes the potential for flexible loads from PEVs to reduce potential future curtailment of “excess” renewable energy.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Grid Communication Interface for Smart Electric Vehicle Services Research and Development [EPC-15-015]

Recipient/Contractor:

Andromeda Power, LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	2/1/2016 to 1/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Technologies and Strategies That Optimize the Benefits of Plug in Electric Vehicles to the Electricity System

Issue:

The increase of distributed energy resources, including intermittent renewables and storage in plug-in electric vehicles (PEVs), makes the coordination of supply and demand to maintain the reliability of the distribution network challenging. PEVs are rapidly expanding in California and this will proportionally increase the installation of bidirectional stations, creating additional demand and stress on the grid. In order to effectively implement vehicle-to-grid (V2G) services, the grid has to be capable of effective machine-to-machine and user-to-machine communication.

Project Description:

Andromeda Power is developing an advanced smart grid communication interface that allows utilities to send dispatch signals to PEVs in real-time to optimize the bidirectional power flow of PEV battery packs depending on local power conditions such as congestion, power quality, voltage and frequency, while maintaining the driver's mobility needs. The grid communication interface operates with a virtual machine able to interface PEVs of any standard. The real time monitoring and control of the stations will provide to the California Electrical Investor Owned Utilities a means of quick Automated Demand Response.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project enables the harmonization of V2G services, removing the communication barrier between PEVs of different standards and the grid. The communication interface enables Smart Demand Side Management benefits to the ratepayer with the possibility of using PEVs as distributed energy storage and controllable load. Local PEVs can mitigate the renewable over-generation and intermittency by storing renewable energy and delivering it to the grid on demand. The additional smart charging incentive can accelerate PEV adoption to achieve the targeted 1.5 million ZEVs on the road by 2025 and 5 million by 2030. Using PEVs as an

<table>
<tr><td colspan="4">energy storage resource can reduce energy demand and stress of the grid, making the load predictable and more manageable.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Alternative Fueled Vehicles: R.13-11-007 Demand Response (DR): R.13-09-011</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1g, 2a, 4a, 5b
Lower Costs:
The annual energy shift capacity introduced by InCISIVE is about 8.2 MWh/year (= 22.5 kWh x 365) toward the end of On-Peak period and in the following Mid-Peak period when marginal electricity is produced by natural gas peaker plants.

Environmental Benefits:
Each PEV used for energy storage is estimated to result in more than 1.3 metric tons per year of additional GHG reductions. Additional GHG reduction can be achieved using PEV batteries to store excess renewable energy to flatten the electric grid duck curve.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$304,177</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$681,693</td><td colspan="2">EPIC Funds Spent:
$573,621</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Verdek: $125,000 (10.9 %)
Suncharge: $340,000 (29.7 %)</td><td colspan="2">Match Funding:
$465,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
25 out of 25 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 5</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project team designed and prototyped two models of Level 2 chargers (ORCA InCISIVE, Strada and Zen) capable of demand response according to the V1G (managed charging) use cases defined by SCE and PG&E. The Andromeda VGI EVSE design includes smart inverter designs to accommodate Rule 21. The EVSEs were installed in the field for durability tests. The project team conducted fast charge/discharge simulation of the PEVs using OpenADR signals and collected performance data. The EVSEs (Level 2 and Level 3) were integrated in a microgrid with 110 kW solar panels to demonstrate the feasibility of the InCISIVE system in mitigating renewable energy overgeneration. The project team is preparing the final report for review and publication.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

A Transformative Flywheel R&D Project

[EPC-15-016]

Recipient/Contractor:

Amber Kinetics, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	1/27/2016 to 3/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S8: Integrate Grid Level Energy Storage Technologies and Determine Best Applications That Provide Locational Benefits

Issue:

Many of the promising energy storage solutions - those with the potential to dramatically reduce cost - are still in the early stages of development. To be commercially viable as an alternative for California's aggressive storage needs, near-commercial energy storage systems require advancements, in both design and manufacturing, to improve performance and reduce costs. Demonstrations are also critical to provide proof of such factors as safety, reliability, discharge duration, and low cost.

Project Description:

This project developed advanced manufacturing processes and improved the flywheel rotor geometries. The project built on developments that the Amber Kinetics flywheel team has made in the areas of enhanced materials processing for better strength, longer life, and improved rotor geometries to maximize energy storage density and reduce the costs. The team also conducted extensive performance testing.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is built on developments that the Amber Kinetics team has made in the areas of improved materials processing for better strength and longer life, as well as improved rotor geometries to maximize energy storage density, thus reducing the cost of the system. The project adds to the energy storage portfolio of options necessary to meet California's storage needs.

CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed]

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Applicable Metrics: CPUC Metrics- 1c, 1i, 2a, 4a, 5b

Lower Costs:

Amber Kinetics substantially improved the commercial readiness of the flywheel system, utilizing the most advanced design and manufacturing techniques available to drive down the cost of flywheel energy storage systems to compete with other existing energy storage technologies (e.g., Lithium-ion, sodium sulfur).

Greater Reliability:

The current grid needs reliable energy storage to allow high penetration of renewable resources such as wind and solar. Amber Kinetics project has demonstrated the flywheel energy storage system that can potentially solve the multiples challenges on the grid. The team improved flywheel technology that has a four-hour discharge capability, and is a cost-effective solution that does not degrade over time and can operate in a wide range of environmental conditions without heating, or cooling which reduces system operating losses and improves grid reliability.

Increase Safety:

Amber Kinetics improved the design of the flywheel and the installation design (below grade or in earth berms) and demonstrated its safety through substantial testing. This performance helps to overcome perceptions of safety issues with flywheels based on past incidents from other flywheel manufacturers that has reduced interest in flywheels as a safe energy storage device.

Environmental Benefits:

Amber Kinetics flywheels have no emissions, consume no water, emit no noise, have no risk of fire or hazardous material spills, and are fully recyclable making them an excellent solution to California's energy challenge.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $388,000
EPIC Funds Encumbered: $2,000,000	**EPIC Funds Spent:** $1,797,868
Match Partner and Funding Split: Amber Kinetics, Inc.: $7,500,000 (78.9 %)	**Match Funding:** $7,500,000
Leverage Contributors: N/A	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	35 out of 38 bidders	Group 2: Ranked # 7

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Amber Kinetics completed their commercial readiness tests of more than 25,000 operating hours. They performed safety validation with burst tests to analyze and improve the flywheel containment design. For grid connection using multi-unit arrays, Amber Kinetics developed communication protocols, multi-array connectivity, charge and discharge operations, and control algorithms for coordinating multiple flywheels, which would be needed in a utility scale deployment. They collected flywheel operational data under real-world conditions to prove the design robustness, reliability, round-trip efficiency, and the ability to balance power and control the state of charge. As a result, Amber Kinetics is expanding its business opportunities in Massachusetts and Australia. A final report was published: https://www.energy.ca.gov/2019publications/CEC-500-2019-012/CEC-500-2019-012.pdf

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems

[EPC-15-018]

Recipient/Contractor:

Eos Energy Storage, LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	3/22/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S8: Integrate Grid Level Energy Storage Technologies and Determine Best Applications That Provide Locational Benefits

Issue:

Residential, commercial and industrial (C&I) customer rates are increasing. Also, outages as a result of natural disasters or to prevent wildfire ignition are increasing. Currently available energy storage technologies for these markets are not economical because of their high cost and short life. Also, safety and energy density limitations have prevented wide-spread deployment of energy storage on a distributed basis or at the point of consumption. Additionally, with new requirements for residential solar, the market is expecting a corresponding increase in the desire for safe and effective residential storage.

Project Description:

The goal of this project is to develop and test behind-the-meter residential and C&I battery storage applications, on both a stand-alone basis and modeled with solar PV. This project is utilizing several kW-scale, AC-integrated Znyth (Trademark) battery technology storage systems. The residential and commercial systems will be located at the University of California, San Diego (UCSD) campus. The project team is developing, modeling, and will be testing experimental rate designs and evaluating the impact on customer load profiles; developing control algorithms and demonstrating aggregation of multiple storage units to create virtual power plants that maximize the value of behind-the-meter storage to the utilities; and modeling, simulating, and extrapolating the economic impacts of installed systems and quantifying the benefits to California utilities and ratepayers.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project aims to validate the safety, reliability, and performance of a new aqueous, zinc-based battery technology to support customer adoption in behind-the-meter energy storage markets and applications. Behind the meter DER application of energy storage has been identified as a major commercial market for energy storage. Detailed field performance data

<table>
<tr><td colspan="2">on the application of energy storage in these behind the meter DER opportunities is critical to the state to open up this market for new and emerging energy storage technologies.</td></tr>
<tr><td colspan="2">CPUC Proceedings addressing issues related to this EPIC project:
Energy storage: R.15-03-011 [Closed] Distribution Resources Plans (AB 327): R.14-08-013</td></tr>
<tr><td colspan="2">Applicable Metrics: CPUC Metrics- 1c, 1i, 2a, 4a, 5b
Lower Costs:
This project will help lower energy costs for residential and C&I customers by providing behind-the-meter energy storage options that may help offset peak use rates and lower demand charge costs.

Increase Safety:
Eos is the only company offering a battery technology that is inherently safer than competing technologies. This technology is non-flammable and non-toxic. In addition to being backed by UL- and ISO-certified quality assurance and control, the manufacturing process involves no toxic or hazardous materials.

Environmental Benefits:
Expanding the use of behind-the-meter storage in the residential and C&I markets will reduce overall loads in conjunction with increasing solar PV, which will reduce greenhouse gas emissions, NOx, and SO2 from existing fossil fuel generators.</td></tr>
<tr><td>Assignment to Value Chain:
Grid Operations/Market Design</td><td>Total Budgeted Project Admin and Overhead Costs:
$218,866</td></tr>
<tr><td>EPIC Funds Encumbered:
$1,894,866</td><td>EPIC Funds Spent:
$770,190</td></tr>
<tr><td>Match Partner and Funding Split:
Eos Energy Storage, LLC: $1,436,801 (43.1 %)</td><td>Match Funding:
$1,436,801</td></tr>
<tr><td>Leverage Contributors:
N/A</td><td>Leveraged Funds:
$0</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	35 out of 38 bidders	Group 2: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Eos completed system design and engineering for the units, including developing C&I skid integration schematics including wiring diagrams; C&I battery management system software; the design for the residential battery rack; assembly of residential battery management system panels; the assembly of the inverter for residential standalone system; and the assembly of the C&I master controls and inverter. Eos has begun the manufacturing and assembly of C&I and residential skids for installation at UCSD, as well as the C&I battery management system cabinets. All components will ship to California for integration in early 2019, followed by installation and commissioning at UCSD.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps

[EPC-15-019]

Recipient/Contractor:

The Regents of the University of California on behalf of the Davis campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Ground-coupled heat pumps (GCHPs) have been proven to deliver heating and cooling at higher levels of efficiency than air-source air conditioners and heat pumps. However, their application in mild climates, like California, is limited by the high cost of conventional ground heat exchangers (GHE), a component of GCHP systems.

Project Description:

This project is researching shallow (20-30 feet deep) and large diameter (2-3 feet diameter) helical coil, ground heat exchanger designs for ground source heat pumps. The project team is developing models, validating them with field data from two home sites and an outdoor lab, identifying optimal designs, and developing modeling methods that can be adapted for use with code compliance tools. The project also produces design specifications that will support future Title 24 eligibility criteria. A design guide is being developed for industry as a training aid, and a position paper is being prepared for the Department of Water Resources' California Geothermal Heat Exchange Well Standards Stakeholder Advisory Group.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project spurs the market for high efficiency GCHPs by evaluating and testing an innovative method to reduce the cost of GHE, whose cost has been a barrier to more GCHP installations. The current method of drilling GHE bores requires costly, specialized deep drilling rigs, that often must be transported from out of state. Instead, by using common, locally available drilling equipment for shallow bores, GHE bore drilling can be done at lower cost. In addition, this technology will be made ready for commercialization by developing modeling tools needed to properly design, size, and evaluate energy savings and to facilitate use with California Title 24 standards compliance tools.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)
Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h

Lower Costs:

This project seeks to reduce the cost of GHEs for heat pumps. Affordable GCHPs may result in lower utility costs for heating and cooling, lower maintenance costs, and improved system reliability compared to forced air systems. Estimated annual energy savings is over 67 billion BTU, assuming 40,000 single family homes built annually and 10% of new homes equipped with GCHPs. Annual electric savings from cooling efficiency in new homes is roughly 1.2 million kWh. For a 2100 sq ft home and a 2 ton system, and comparing the incremental cost for a GCHP system with conventional HVAC system, the annual cost savings per home is $173, when amortized over 30 years with tax credits.

Environmental Benefits:

Assuming a 10% market penetration on new homes, estimated greenhouse gas emissions would be reduced by 8 million pounds per year.

Consumer Appeal:

Increased use of GCHPs would eliminate noisy and visually unappealing outdoor condensing units. Also, GCHPs could improve comfort for residents compared to forced air systems.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $361,292	
EPIC Funds Encumbered: $1,212,186		**EPIC Funds Spent:** $445,828	
Match Partner and Funding Split: Frontier Energy, Inc.: $18,826 (1.5 %)		**Match Funding:** $18,826	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 12

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The team is installing instrumentation at the outdoor lab site. The data from this site will be used to develop a model to study the optimization of the ground heat exchanger design. The team is developing a test plan to coordinate experiments to validate its model. The validated model will ultimately be used to develop relationships describing the performance of shallow-bore, helical ground heat exchangers for use in EnergyPlus.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Intelligent HVAC Controls for Low Income Households: A Low Cost Non-connected Device that Understands Consumer Preferences and Performs Adaptive Optimization

[EPC-15-020]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	3/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

HVAC energy use in low income households, in many cases is the largest component of energy use. However, the efficiency issues associated with HVAC units are largely unaddressed due to cost, ownership and complexity of the systems. By targeting the so called "low hanging fruit", such as control mechanisms, energy savings could be realized with minimal cost to the tenant. However, monitoring and verification of energy savings is needed before building owners/operators are convinced of the benefits and savings.

Project Description:

This project is developing a low-cost smart thermostat with a simplified user interface. It is being tested in low-income and senior housing, but can be readily adapted to other building sectors, including small commercial. The smart thermostat will track user preferences and manage indoor conditions to optimize energy use. Internet connectivity is not required. By automatically optimizing thermostat settings, this project determines if smart thermostats can be a cost-effective method to address HVAC energy use in sectors where it does not make sense for building owner or tenant to make HVAC system upgrades.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project bridges a technology connectivity gap in low-income and senior communities. Current smart thermostats are expensive, and a lack of broadband internet access makes these devices a bad fit for the low-income market. Developing a low-cost, internet-independent device creates opportunities to expand smart grid infrastructure and capture energy savings associated with automated controls in hard to reach building sectors.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1g, 1h, 3a, 4a

Lower Costs:

This project will leverage lower-cost hardware and software platforms to develop a cost-effective smart thermostat option of approximately $60. By providing a more cost-effective thermostat, this project could leverage utility and other incentives for a no-cost option for homeowners. By increasing adoption of smart thermostats this project will help lower energy use and costs from a generation and end-use level. At the end use level, smart thermostats have the potential to reduce HVAC energy use and costs by 10 to 15%.

Environmental Benefits:

Development of a smart thermostat has the potential to reduce HVAC energy use. Energy saved at a building level means less energy required at a generation level, therefore potentially reducing the need to burn fossil fuels to generate electricity when renewable energy may not be available. The aggregate reduction in carbon dioxide (CO2) emissions imparted by the proposed thermostat just from low-income customers translates to approximately 175,000 metric tons. Including small commercial, emissions can be reduced by 218,000 metric tons.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $903,766	
EPIC Funds Encumbered: $2,705,759		**EPIC Funds Spent:** $694,957	
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $427,072 (13.6 %)		**Match Funding:** $427,072	
Leverage Contributors: N/A		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 11

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The team recently completed hardware design for the prototype thermostat. Application development including user experience is ongoing and will undergo early stage testing in December 2018. Full scale pilot testing will begin in early 2019 when benefits will begin to be quantified.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Mobile Efficiency for Plug Load Devices

[EPC-15-021]

Recipient/Contractor:

AGGIOS, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/1/2016 to 12/31/2018

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Typical smartphones consume 0.03 W when idle and less than 1W when in use. In comparison, typical set top devices, like satellite and cable, home and office computers and other internet protocol devices, use 100-1000 times more power when idle and 5-50 times more power when in use compared to mobile devices. From the end user's perspective all these devices are converging and increasingly offer similar information, video, audio and other services. Therefore, research is needed to improve power management on the major types of plug load devices so that they can approach the efficiency equivalent of mobile devices.

Project Description:

This project designed a methodology guideline for plug load manufacturers to use in developing energy efficient plug load devices. In developing the guideline, the recipient will evaluate mobile design practices, hardware components, and power management software kernels to prove their effectiveness. The results were used to develop the first virtual prototypes and reference designs for energy optimized hardware and software that can guide plug load device manufacturers to reach mobile energy efficiency levels. Manufacturers will use these reference designs to develop and mass deploy energy efficient plug load devices into the marketplace. When these reference designs are used there should be a reduction of energy consumption of residential and commercial plug load devices, such as set-top boxes, TVs, computers, and game consoles. The project defined and introduce a widely accepted industry standard through the Institute of Electrical and Electronics Engineers (IEEE) to support the newly developed unified design methodology and secure its long-term adoption and further evolution.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project advanced a methodology guideline to help plug load manufactures develop

<table>
<tr><td colspan="4">energy efficient plug load devices. The recipient is conducted detailed technical analysis on new software, hardware and power management design and verification methodology, conducted tests on virtual prototypes, verified energy savings, and developed reference designs, in the form of design guidelines. This information is available to the plug load device manufacturers and their suppliers to help accelerate the adoption of mobile efficiency practices across multiple product categories in the shortest time and the lowest costs. As many current plug load devices in the market lack any power management capabilities, similar to those in smart phones, this project paved the way for plug load manufacturers to advance those capabilities into other plug load devices.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h
Lower Costs:
This project has the potential to reduce energy use and costs across a broad array of plug load devices. If deployed, the estimated potential energy savings is 20% to 50% per plug load device.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$136,800</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,996,999</td><td colspan="2">EPIC Funds Spent:
$1,797,826</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
AGGIOS, Inc.: $225,000 (2.8 %)
Freescale: $20,000 (0.2 %)
International Rectifier: $225,000 (2.8 %)
Keysight: $65,000 (0.8 %)
Mentor Graphics: $4,350,300 (54.2 %)
Synopsys: $1,145,150 (14.3 %)</td><td colspan="2">Match Funding:
$6,030,450</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 19 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

- Functional Specification Document Architecture Specification Document
- Automatic Energy Design and Management System
- SEED - Software Defined Power Manager
- EnergyLab - Software Toolkit for Energy Analysis and Software Generation
- UHAL - Unified Hardware Abstraction Language
- Functional Specification Document Architect

Update:

The project is complete and the final report will be published January 2019. The project team completed the energy modeling of the power management system and its use. The team completed an application to IEEE to create standardized energy efficient specifications for plug load devices. This process may take up to two years. The standardization efforts are a key factor in enabling wider adoption of efficiency reference designs to allow a standard, comparable assessment of energy use of various plug load devices. Increased use of reference designs and programming of more efficient standby modes has the potential to reduce annual energy consumption by 20-50%.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Power Management User Interface

[EPC-15-022]

Recipient/Contractor:

The Regents of the University of California, Irvine Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/1/2016 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Personal computers typically do not employ existing power management capabilities and are left on idle mode. This practice results in an increasingly large proportion of energy consumption in homes and businesses.

Project Description:

This project seeks to reduce energy consumption in personal computers by improving how users employ existing power management capabilities. Although all computers have the capacity to enter low-power modes such as sleep, and can be shut down when not in use, this potential for energy savings has not been realized in the majority of desktop computers. These computers remain on at full power when they are not used. The problem is one of user behavior. The project uses a software solution to change user behavior by changing the tool they are using. This approach is firmly based in behavior theory and human-computer interaction research, which have long demonstrated that the interface of a device can change users' behavior.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The Recipient will develop and test a new user interface designed to facilitate and encourage greater utilization of low-power modes by computer users. The interface design will incorporate lessons from the fields of human-computer interaction and behavior theory. The field test will provide data that will improve understanding of user behavior toward computer power management.

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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs:

Lower energy use results in reducing operating costs for consumers. The energy savings is estimated to be as high as 50 percent per computer, or about 139 kWh per year or up to approximately $35 per year.

Environmental Benefits:

Reducing energy use will result in greenhouse gas emission reductions.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $300,159
EPIC Funds Encumbered: $785,124	**EPIC Funds Spent:** $611,153
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 19 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 6

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

The recipient is preparing the final report. The team has completed the Software Development Report for the Power Management User Interface Study and has produced a fully functional software that is ready and an improvement over the initial prototype. The recipient has conducted field tests of the software on university staff desktops with more than 300 staff participants. Preliminary results indicate savings of over 50 percent per computer or about 139 kWh per year. The baseline computers used were more efficient than originally estimated, and although the percentage energy savings was high (as high as 61%), the total energy savings (net kWh) was lower than the originally estimated.

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Project Name: Gaming System Energy Efficiency without Performance Compromises [EPC-15-023]	
Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/1/2016 to 12/31/2018
Program Area and Strategic Objective: Applied Research and Development S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector	
Issue: More than 1 billion people around the world engage in digital gaming. The approximately 20 million gaming platforms in use in California include 7 million mainstream personal computers used partly for gaming, 1.5 million specialized high-power PCs known as Gaming PCs (GPCs), and 12 million Video Game Consoles (VGCs). It is estimated that these platforms collectively consume 5% of total residential electricity and 18% of residential miscellaneous plug loads in California (and an unknown share of non-residential plug loads).	
Project Description: This project provided a detailed market segmentation and baseline energy demand assessment of the gaming market, including development of measurement and benchmarking protocols for gaming software and hardware. Top-selling gaming PCs and games are then cross-benchmarked and retrofitted to achieve maximum energy savings beyond what commercialized products currently can attain.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project advanced the design of energy efficient of video gaming computers and consoles by demonstrating system designs that are significantly more efficient than current market offerings. The research results may influence component and integrated system manufacturers and game developers to bring more energy efficient video game computers and consoles into the market without sacrificing the gaming experience. The project identified potential opportunities for codes and standards improvements and/or utility incentives. California ratepayers may benefit by having lower energy use and costs associated with their gaming systems without compromising their video game choices and experience.	

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs:

This project's results if implemented may reduce the energy "bill" for a typical gaming personal computer by $236/year (assuming a 75% savings potential), which is more than any other miscellaneous plug load.

Environmental Benefits:

By reducing energy use, the project will also reduce greenhouse gas emissions.

Consumer Appeal:

Gamers are intently focused on noise, heat management, and thermal comfort. Energy efficiency improvements will not impact these elements but could result in less heat and increased thermal comfort.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $658,250
EPIC Funds Encumbered: $1,386,530	**EPIC Funds Spent:** $1,386,530
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors:	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 19 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 5

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: ">This project is completed and the final report will be published in January 2019. The team conducted energy use testing and analysis of video game computers and consoles, including testing the same game on various devices. The team found no relationship between energy use and device type. There is no regulation affecting this industry yet, so the team recommends establishing voluntary standards similar to Energy Star. The standards would cover: energy ratings, power component rankings, and energy game ratings. The information from this project is available and has been shared to the California Energy Commission to influence codes and standards for computers and video game consoles, and encourage manufacturers to reduce the energy use of these devices.

Project Name: Efficient and ZNE-Ready Plug Loads [EPC-15-024]	
Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 4/11/2016 to 4/30/2019
Program Area and Strategic Objective: Applied Research and Development S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector	
Issue: Plug load devices require the conversion of grid power from alternating current (AC) to direct current (DC) and these devices spend long periods of time in standby mode, creating inefficiency in current plug load devices. There is a need for energy efficient plug load technologies and strategies to reduce electrical consumption.	

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Project Description:

This project researches and develops new technologies and strategies to eliminate or significantly reduce energy use in standby mode by redesigning the power supply for plug load devices. This project also develops and demonstrates strategies to remove plug load devices from grid AC power by redesigning these devices to use DC power from photovoltaic power sources.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Standby power use is the electricity consumed by almost every electrical consumer device plugged in to an electrical outlet. Standby power is responsible for roughly 5% of California's residential electricity use. This project will develop an innovative family of zero-standby technology solutions and will enable the next generation of electrical devices to draw zero standby power while providing the full range of functionality that are desired by consumers.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a

Lower Costs:

Implementation of the recommendations could lower the cost of electricity to the consumer by an estimated $750 million per year through the elimination of standby power and electrical losses from converting DC to AC.

Environmental Benefits:

Implementation of the recommendations has the potential to reduce energy use up to 5,100 GWh/year, resulting in the estimated reduction of 1.2 million metric tons of CO2e.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $634,531
EPIC Funds Encumbered: $1,600,000	**EPIC Funds Spent:** $941,352
Match Partner and Funding Split: EMerge Alliance: $50,000 (2.4 %) Power Integrations: $75,000 (3.6 %) Delta Electronics: $100,000 (4.8 %) Lawrence Berkeley National Laboratory: $270,000 (12.9 %)	**Match Funding:** $495,000

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Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 19 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 2
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: The project is on track and the draft report is expected in March 2019. The researchers are reviewing technologies for energy harvesting and energy storage in order to identify those most suitable for pairing with a power supply. They are also working on identifying energy efficiency technologies to integrate into selected plug loads that take into account human behaviors and device functionalities. CPR #2 was conducted in June 2018. An abstract paper by Alan Meier, the principal investigator of the project on "Zero Standby Power Supply" was presented at 2018 ACEEE summer study as part of the knowledge transfer activities.			

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Project Name:

Plug Load Reduction App:RYPL

[EPC-15-025]

Recipient/Contractor:

Home Energy Analytics

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	4/11/2016 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Plug loads or miscellaneous electrical loads (MELs) are the fastest growing category of residential electricity consumption and the idle load represents a surprisingly large percentage of the electricity used in California homes - on average 218 Watts across 70,000 homes. In addition, there is no accurate and reliable way to guide residents in choosing actions to reduce the idle load and no accurate way to track their progress if actions are taken to reduce the idle load.

Project Description:

This project researches methods to reduce home idle loads by utilizing smart meter analytics, an engaging smart phone app, a new online crowd-sourced database of miscellaneous electric loads, and an online efficient product marketplace to educate California residents about the idle load of their home and ways to reduce it. The system is to be piloted within all three electric investor owned utility territories and measure actual energy savings through smart meter data.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Idle load is a new concept to most residential energy users and includes appliances and equipment in the off or standby mode but still drawing power. The recipient has developed an innovative smart phone app called Dr. Power which provides residents with information about their idle loads, provides ideas and a plan to reduce the idle loads, and correlates any energy saving actions with smart meter data. This simple to use app tests the theory that if accurate information about energy use is provided to consumers, they will be more likely to engage and take action. This technology has the potential to advance consumer knowledge and overcome barriers to reducing idle loads that could hinder the State's goal of doubling energy efficiency by 2030 and/or achieving zero net energy buildings in the future.

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<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11
Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h
Lower Costs:
Use of the Dr. Power app helps residential customers understand the energy use of their home appliances and electronics and provides ideas on how to reduce consumption. When residents take action, this could result in lower energy bills by an estimated 10% due to a reduction in idle loads.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$634,531</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$884,100</td><td colspan="2">EPIC Funds Spent:
$824,984</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Enervee Corporation: $300,000 (24.3 %)
Home Energy Analytics: $50,000 (4.1 %)</td><td colspan="2">Match Funding:
$350,000</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 19 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The recipient released minor updates to both the Android and iOS versions of Dr. Power. The project currently has 529 Dr. Power users, adding 25 users between September 2019 and November 2019. Most users are in the PG&E service area and the recipient is working with</td></tr>
</table>

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SDG&E and SCE to add several thousand more from their service area. The recipient is focusing on increasing outreach and using methods that will have long term sustainability and increase the user base even after the end of the agreement. Software enhancement is currently in progress to allow Dr. Power to deploy to more homes.

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Project Name:

Unlocking Plug Load Energy Savings through Energy Reporting

[EPC-15-026]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/1/2016 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector

Issue:

Plug loads account for an increasing portion of electricity consumption in both residential and commercial buildings. Recent surveys indicate that plug loads are responsible for at least 25 percent of building electricity use nationally, and even more in California.

Project Description:

This project is developing an interoperable protocol that can be implemented in all plug-load devices, unhampered by proprietary restrictions which will implement energy reporting to enable plug-load devices to transmit operating information - such as identity, power consumption, and functional state - through a communications network to a central entity. After a communication infrastructure is established for plug-load devices, the data flow can be reversed to send control signals to individual devices. The central management system that this project will demonstrate is well positioned to provide comprehensive control over diverse plug-load devices.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Building operators and end users do not have a clear or accurate tally of the plug load devices in their buildings, how much energy is used or how they could be better controlled to save energy. The recipient is developing inexpensive, proprietary-free technologies that can acquire energy use data for networked plug load devices and make them available to building owners. The technologies will be able to identify abnormally large plug load energy use and enable building owners to react to its energy use. The technology could be incorporated directly into California's building codes and other energy efficiency standards.

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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 3a, 4a

Lower Costs:

In California, energy savings could exceed 5 TWh/year in residential and commercial buildings. More savings should result from applying the technology to other plug load devices such as appliances. The technology could result in a demand reduction of more than 700 megawatts. The energy savings could result in lower energy costs for consumers.

Environmental Benefits:

The project could reduce energy consumption and greenhouse gas emissions by more than 1.7 gigatons per year.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $123,700
EPIC Funds Encumbered: $1,630,699	**EPIC Funds Spent:** $1,048,910
Match Partner and Funding Split: Energy Solutions: $94,318 (4.4 %) The Watt Stopper: $50,000 (2.4 %) Lawrence Berkeley National Laboratory: $350,000 (16.5 %)	**Match Funding:** $494,318
Leverage Contributors:	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 19 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

List of device types created by LBNL with funding from Northwest Energy Efficiency Alliance. Made available for use by UPnP (Universal Plug and Play) which has been since merged into OIC (Open Interconnect Consortium). This list will be recommended for incorporation into other technology standards. A report on this at: http://nordman.lbl.gov/docs/lbnl-classification-v1.pdf.

Update:

The project team has finished remote harvesting of energy usage data from all ten devices being tested. Devices tested include those for a water heater, light switch, Macbook, and a vehicle charger. The project team has begun collaboration with the Energy Commission's Appliance Standards and Building Codes teams to discuss opportunities to develop code change proposals.

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Project Name: Electric Plug Load Savings Potential of Commercial Foodservice Equipment [EPC-15-027]	
Recipient/Contractor: Fisher-Nickel, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/16/2016 to 3/31/2020
Program Area and Strategic Objective: Applied Research and Development S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector	
Issue: The main barriers preventing adoption of advanced appliances in commercial food service has been a combination of the industry's lack of knowledge and energy data. An equally important barrier to the adoption of optimized energy mode technologies is the operator's apprehension that the appliance will not be ready to use when needed; that the amount of time required to heat the appliance will delay product delivery and hinder the "speed of service" to the customer. Another operator concern is that that product quality will suffer when this type of technology is applied to appliances that are designed to maintain food-safe temperatures.	
Project Description: This project assesses the reduction potential of electric commercial plug load foodservice equipment at five different commercial kitchens and demonstrates the potential for reduced energy consumption through the use of pre-commercial appliance designs and control technologies.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The project advancement is to bridge the knowledge gap and support the accelerated adoption of advanced appliances and controls by better understanding operator behavior and operational changes that can be made to successfully use new lower energy appliances. The results of this effort will be used to develop real world case studies of successful implementation of next generation plug load appliances, and provide training to food service operators to maximize energy reduction potential for food service equipment. In addition to food service operators, the research results will assist equipment manufacturers in further	

<table>
<tr><td colspan="4">product development of energy efficient food service equipment and help justify development of utility incentives for purchasing and installing energy efficient foodservice equipment.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e, 1f, 1h
Lower Costs:
This project could lower energy costs by encouraging the adoption and implementation of advanced design and controls for commercial food service plug load appliances that use less energy than conventional systems. On a per-appliance basis, amounts would range from $71/year for a single hot plate to $950/yr for a single espresso machine. Savings on the equipment could total up to $2,643 annually if energy saving controls were optimized for each appliance and the site has a combination of a vertical toaster, food warmer, hot plate, rice cooker, and soup warmer in its kitchen.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$392,763</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$937,469</td><td colspan="2">EPIC Funds Spent:
$347,278</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Fisher-Nickel, Inc.: $1,377 (0.1 %)
Pacific Gas and Electric Company: $148,623 (13.0 %)
Dalla Corte: $20,000 (1.8 %)
Nuova Simonelli: $18,350 (1.6 %)
Hatco: $4,100 (0.4 %)
NAFEM: $10,000 (0.9 %)</td><td colspan="2">Match Funding:
$202,450</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 19 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 4</td></tr>
</table>

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project currently has 19 different sites in California and is continuing to add and grow the existing data base of test sites. The recipient has collected baseline data and installed new equipment at most of these restaurants. Plug load meters were installed at each of the test sites to determine baseline electrical consumption. Depending on logistics and site flexibility, between two weeks and three months of baseline data was collected. The field data thus far showed that commercial foodservice plug load equipment has a wide range of energy intensity, based on the operation type and hours. Cumulative energy savings for all plug load equipment can be substantial. The appliance with the highest average daily energy use, the conveyor toaster, used more than 20 times the energy on average than the appliance with the lowest average daily energy use, the soup warmer.

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Project Name:

Real World Electrification Options of Energy Services and Environmental Justice (EJ) Considerations

[EPC-15-028]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/13/2016 to 5/13/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Electrification of customer energy technologies and services can create a number of benefits for California ratepayers and residents, including improved air quality, reduced greenhouse gas emissions, and significant cost savings. However, not all electric technologies are automatically beneficial. The cost-to-benefit ratio varies widely with each application, and there are many different technologies and hundreds of applications. Understanding how each electric technology contributes to a significant electrification scenario is critical to both an understanding of the societal benefits and real world implementation of programs designed to achieve electrification objectives.

Project Description:

The research team is conducting a statewide assessment - at the zip code level - of the potential for electrification (e.g., use of electricity for space heating) to generate benefits to customer cost savings, statewide economy, climate, and air quality. The assessment will feed a comprehensive climate and energy model and a subsequent air quality analysis that will help determine public health benefits, with a focus on the South Coast and the San Joaquin Valley air basins.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The analysis of health and air quality benefits alongside costs of electrification under this agreement is forming the basis for new cost-benefit metrics that can be used to assess the economic viability of breakthrough technologies. Cost-benefit analyses of this sort can be used to make evidence-based decisions regarding technology financing and deployment.

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CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1f, 1h, 2a, 4a, 4b

Lower Costs:

Electrification of customer energy technologies and services can create a number of benefits for California ratepayers and residents, including improved air quality, reduced greenhouse gas emissions, and significant cost savings. The project will show cost and benefits to utility customers of specific electrification technologies like off-road vehicles and efficient heat pumps.

Environmental Benefits:

The benefits from this research are predicate to achieving wider-spread benefits of electrification for public health and the environment. Electrification of customer energy technologies, including homes, businesses, industry, and mobile sources can reduce greenhouse gas emissions. Initial research suggests that peak ozone concentrations in the South Coast Air Basin could be reduced by up to 5 parts per billion by 2030 and transportation greenhouse gas emissions reduced by up to 65% by 2050 through electrification. The research in this project will evaluate potential benefits of specific electric technologies and how to best target geographic areas for electrification to achieve state goals.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $234,351
EPIC Funds Encumbered: $799,444	**EPIC Funds Spent:** $367,636
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $609,213 (39.1 %) South Coast Air Quality Management District: $150,000 (9.6 %)	**Match Funding:** $759,213
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	45 out of 45 bidders	Group 2: Ranked # 1
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: The research team has developed draft long-term electrification scenarios for the residential, commercial, and transportation sectors. These scenarios have been translated to emissions of conventional air pollutants at relatively fine geographical resolution and with the necessary temporal resolution for sophisticated photochemical modeling. Results so far suggest substantial improvements in air quality. The research team is now in the process of preparing parts of the final report for the review by the members of the technical advisory committee.			

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Project Name:

Distributed Generation Environmental Planner

[EPC-15-029]

Recipient/Contractor:

Black & Veatch Corporation

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 1/31/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Site information required for project siting and permitting of solar photovoltaic (PV), in particular environmental and distribution system interconnection data, are not widely available or accessible to project developers, local planners, utilities, landowners, and other stakeholders in an organized, centralized location. Having this information early in the siting process could reduce project development costs and the uncertainty of lengthy and complicated environmental permitting processes. Tools exist to perform similar functions for landscape scale planning, but it is not known whether they can be successfully adapted for local distributed PV planning.

Project Description:

This project developed a tool to identify environmentally preferred areas for distributed solar generation (DG). The project demonstrated how disparate spatial information, such as solar capacity, environmental data, and utility infrastructure, can be combined in a site screening tool for effective local DG planning. The project aimed to expand energy planning tools at the local level by leveraging the ongoing development of a statewide planning tools. The existing statewide tool (prototype currently called the "RE Infrastructure Planning Assistant") focuses primarily on environmental screening for utility scale renewable energy development. This project adds more detailed energy and economic information appropriate for distribution-scale solar siting and most importantly incorporates distributed generation into the prototype interactive mapping tool and tests it in Lancaster, California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This agreement created a prototype, public tool (http://dg-solar.org/) that enables DG PV site selection by providing users both environmental and engineering geospatial data. Having proven the concept in Lancaster, CA, the tool may be expanded to other areas of California

<table>
<tr><td colspan="4">that have similar availability of input data. Making information more comprehensive and accessible at the DG level will improve market functioning, while also enabling better DG infrastructure planning that incorporates environmental conservation.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 4f
Lower Costs:
Benefits include reduced siting and permitting risk, reduced development risk, and time and cost savings in the development cycle. Cost savings could accrue to permitting agencies, utilities, ratepayers, and other stakeholders, especially in regions vulnerable to environmental conflict.

Environmental Benefits:
The tool helps to identify areas with low conservation value for species and habitats that could be suitable for renewable energy with least impact or conflict to wildlife.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$44,350</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$199,976</td><td colspan="2">EPIC Funds Spent:
$199,536</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
45 out of 45 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 5: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project was completed in 2018. The final report is available online at http://www.energy.ca.gov/2018publications/CEC-500-2018-010/CEC-500-2018-010.pdf. The research team designed the technical specifications of the planning tool, developed the web-based application, and compiled and processed spatial data. The tool combines solar resource, environmental sensitivity, cost, and interconnection spatial data layers in a single GIS application. The format of the tool allows user-entered values for a variety of screening parameters that may be of interest to developers, local planners, and government officials. The tool returns maps and lists of parcels that match the user-entered criteria and then generates reports. The completed tool went live online in 2017. The TAC member from sPower is interested in using the tool to guide future solar development in Lancaster.

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Project Name:

San Diego Regional Energy Innovation Cluster

[EPC-15-030]

Recipient/Contractor:

Cleantech San Diego Association

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan 2015-2017 Triennial Investment Plan	7/15/2016 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development

Market Facilitation

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies
S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

Clean energy startups face difficulties in making use of the existing programs and resources available in the area, and accessing technology validation facilities, business training, market intelligence, and capital. They also experience increasing challenges navigating regulatory barriers to development and commercialization of entrepreneur's innovations. In order to facilitate the development of new energy innovations and their entry into the market, the various entrepreneurial support services available in the region must be coordinated under one directive, optimizing key services to meet the needs of individual businesses.

Project Description:

This project has developed a collaboration of clean energy organizations in the San Diego Region to provide and coordinate key services, resources, and infrastructure needed by entrepreneurs and researchers in the region. The project aims to accelerate the successful market entry of energy innovations that can benefit electric ratepayers. This project is also working with businesses, local jurisdictions and other organizations in the region to connect emerging technologies to region specific-needs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is advancing the goals of SB 350 (2015) by accelerating the commercialization of new clean energy technologies that can enable the integration of high-penetrations of renewables and distributed energy resources. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity

costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

This project will help shorten technology development time and costs by providing a one-stop shop for entrepreneurs to quickly find and access the right services and resources.

Economic Development:

This project will help facilitate successful clean energy entrepreneurship, leading to increased private sector investment and local job creation.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $880,681
EPIC Funds Encumbered: $5,000,000	**EPIC Funds Spent:** $1,192,051
Match Partner and Funding Split: Cleantech San Diego Association: $2,876,060 (35.5 %) CONNECT: $221,874 (2.7 %)	**Match Funding:** $3,097,934
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 6 out of 12 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: In 2018 the San Diego Regional Energy Innovation Network (SDREIN) expanded the number of supported companies to over 25. These companies are developing innovations in areas such as storage technology, EV smart charging, and DER aggregation. Collectively, these companies have gone on to attract over $15 million in private follow-on funding and over $9 million in public follow-on funding since being accepted into the program. The SDREIN was also awarded a $750,000 grant from the U.S. Economic Development Administration's i6 Challenge. This additional funding will be used to expand SDREIN services into the Inland Empire region.

Project Name: Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response [EPC-15-031]	
Recipient/Contractor: Electric Power Research Institute, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/2/2016 to 3/31/2020
Program Area and Strategic Objective: Applied Research and Development S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector	
Issue: Consumer power consumption from electronic and miscellaneous plug loads pose large load profiles. Plug loads are not typically targeted by utility energy efficiency nor demand response programs. Consequently, plug load energy consumption and integrated plug load control strategies are not well-understood or developed. However, California's policies drive the need to better manage the growth.	

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Project Description:

This agreement develops integrated plug load control strategies for different spaces within multiple types of commercial buildings. The project implements a flexible energy management system (FEMS) to demonstrate the integrated control strategies for plug loads at pilot sites. This includes the installation of smart power outlets and integration of various plug load control strategies with building energy management and/or lighting control systems. The project demonstrates and measures the degree of effectiveness of the flexible control strategies developed for integrally managing operation of plug loads to achieve energy efficiency and demand reductions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

In order to reduce plug load energy use and increase the energy efficiency of buildings, this project advances flexible energy management systems coupled with smart power outlet technology to control plug load use. The project will also enhance integrated strategies for operating different plug load types to achieve energy efficiency and demand response. The results of this project can potentially reduce electricity use in commercial buildings, particularly during low-occupancy times and in user-assigned spaces, thereby achieving lower electricity costs for the ratepayer.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h

Lower Costs:

The developed cost-saving plug load control strategies will clarify display designs, control settings and incorporated behavioral considerations. The identified strategies could potentially reduce electricity use by 10% from plug loads, particularly during low-occupancy times and in user-assigned spaces. This would lead to a reduction in electricity cost of commercial ratepayers.

Greater Reliability:

The developed technology will identify potential demand response strategies through coordinated operation of plug loads in an integrated building system environment. This could help support power and market systems, particularly during critical periods when the grid is stressed or prices are high.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$366,082

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<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,050,022</td><td colspan="2">EPIC Funds Spent:
$133,542</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Enmetrics Systems: $24,120 (1.7 %)
Ibis Networks: $51,000 (3.7 %)
SkyCentrics: $10,000 (0.7 %)
San Diego Gas & Electric Company: $30,000 (2.2 %)
To Be Determined: $30,000 (2.2 %)
TBD - Technical Writer: $25,000 (1.8 %)
Electric Power Research Institute, Inc.: $165,000 (11.9 %)</td><td colspan="2">Match Funding:
$335,120</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 19 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project team is evaluating the plug load controls at both their Stanford laboratory setting and AP+ Design architecture design test sites. The controls were installed at both sites in 2017. Analysis will be conducted on the 1+ year of data collected to determine effectiveness in achieving energy efficiency and demand reductions.</td></tr>
</table>

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Project Name:

Bay Area Regional Energy Innovation Cluster

[EPC-15-032]

Recipient/Contractor:

Activation Energy, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan 2015-2017 Triennial Investment Plan	5/12/2016 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development

Market Facilitation

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies
S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

Long development times, high capital requirements, and long sales cycles for hard energy technologies have all contributed to an extremely difficult financing environment for hard energy innovators. In particular, venture capital investment, the main source of private sector support for early stage technology companies, has declined sharply for hard energy technology in the past several years. Unfortunately, no reliable, alternate source of private capital has emerged, due to the high risks associated with early stage energy technology development.

Project Description:

This project established the Bay Area Regional Energy Innovation Cluster by expanding the Cyclotron Road program to provide commercialization support services to Bay Area entrepreneurs developing breakthrough materials and hardware devices in energy efficiency, energy storage, distribution, grid management, and power generation. Cyclotron Road provides entrepreneurs access to world-class laboratory facilities, and key services, such as business model development, customer discovery, and intellectual property protection to enable energy entrepreneurs in the Bay Area region.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will help advance the goals of Senate Bill 350 (De Leon, 2015) by accelerating the commercialization of clean energy technologies, including energy efficiency, demand response, renewable generation, energy storage, and smart-grid integration. This project will

<table>
<tr><td colspan="4">increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Smart grid: R.08-12-009 [closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 3b, 3e
Lower Costs:
This project will decrease the time and costs for new technology development by providing entrepreneurs with the services and facilities they need to commercialize their technology.

Economic Development:
This project will help facilitate successful clean energy entrepreneurship, leading to increased private sector investment and local job creation.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$282,411</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$4,980,000</td><td colspan="2">EPIC Funds Spent:
$919,548</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
DLA Piper LLP: $90,000 (0.6 %)
Lawrence Berkeley National Laboratory: $4,150,000 (29.7 %)
Activation Energy, Inc.: $260,000 (1.9 %)
Autodesk, Inc.: $4,500,000 (32.2 %)</td><td colspan="2">Match Funding:
$9,000,000</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
6 out of 12 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: In 2018, Cyclotron Road accepted its fourth cohort of fellows into its program. This latest round of entrepreneurs is developing innovations in areas such as long-duration energy storage, enhanced geothermal systems, and biomass torrefaction. The fellows will spend the next two years working on bringing their technologies closer to market, and have already attracted additional investments from ARPA-E and Breakthrough Energy Ventures. In addition to supporting the latest cohort of fellows, the project team expanded their publicly available resource library to include an online video series on techno-economic modeling. The resource library is available at http://www.cyclotronroad.org/resource-lab/. In 2019, Cyclotron Road will bring on a fifth cohort of entrepreneurial scientists and engineers as it continues to support advancements in clean energy hardware technologies

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Project Name:

Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC

[EPC-15-033]

Recipient/Contractor:

Regents of the University of California, Davis

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Research indicates that many California classrooms are under-ventilated relative to rates specified in Title 24 and ASHRAE 62.1. Simply increasing outdoor air ventilation rates in classrooms has pitfalls: it will increase energy use, and it can have the unintended negative consequence of increasing student exposures to outdoor air pollutants. As California looks ahead to achieving 50% energy use reductions in existing and future ZNE schools, there is a need to demonstrate ventilation approaches that are substantially more energy efficient than current, minimally code-compliant systems.

Project Description:

Several technologies that deliver HVAC services and energy savings are being field tested at several schools in California. The identified technologies in this study include heat recovery ventilators, air economizers, demand control ventilation, displacement ventilation, high performance filtration, and learning thermostats. These are advancements that are over and above the technologies typically used in California schools, and can greatly improve the energy efficiency of providing heating, cooling, and ventilation in classrooms.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The agreement provides information on indoor air quality and energy usage in classrooms with current HVAC systems throughout different parts of California. The project then evaluates next generation HVAC system retrofits with regards to energy efficiency and indoor air quality performance. The results will enable energy savings without impacting indoor air quality in classrooms. The study is the first large field study to examine the energy efficiency upgrade and indoor air quality impacts after the recent energy retrofit.

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CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 4b, 5d

Lower Costs:

By field testing several HVAC technologies that provide significant savings over existing systems, this project will result in energy savings from improved equipment performance and lower costs associated with delivering thermal comfort and improved indoor air quality in classrooms.

Public Health:

This project will provide data on indoor air quality in classrooms that have both current and state-of-the-art HVAC systems. The results will enable future HVAC deployment in California that provides both energy savings and improved indoor air quality, improving the health of students at schools throughout California. Interim results will be used to educate schools about the steps they can take to improve ventilation in classrooms.

Assignment to Value Chain: Distribution		**Total Budgeted Project Admin and Overhead Costs:** $439,287	
EPIC Funds Encumbered: $1,500,000		**EPIC Funds Spent:** $882,162	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

The research team collected indoor air quality monitoring, ventilation, and energy usage data from 104 classrooms in 11 schools that use current HVAC systems. The characteristics of the classrooms and schools include locations, district sizes, grades, free/reduced lunch percentage, and equipment types. A teacher survey on usage of the HVAC system in classrooms was also completed with an excellent response rate. The monitoring data provides the baseline for energy performance and indoor air quality condition for the current HVAC system. The research team has installed and commissioned two next generation HVAC systems on two demonstration schools. The data collection process is ongoing until the end of 2018.

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Project Name: Clarifying and Quantifying Current and Near-Term Groundwater Pumping Energy Use and Costs in California to Improve Energy and Water Systems Reliability [EPC-15-035]	
Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/1/2016 to 6/30/2019
Program Area and Strategic Objective: Applied Research and Development S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts	
Issue: The current lack of empirical research aimed at characterizing the relationship between energy use and groundwater pumping prevents accurate resource planning. Previous studies show that the water sector represents at least 7.7 percent of statewide electricity needs. The actual percentage of energy used for groundwater pumping is unknown. Similarly, the social barriers to decreasing pumping related energy use are poorly understood, as are options for overcoming those barriers.	
Project Description: The project is quantifying current statewide energy use and costs attributable to groundwater pumping and developing near-term projections of energy use and statewide costs. The projections will factor in groundwater demand, groundwater levels, climate change scenarios, energy prices, and obstacles to implementing energy-efficient pumping and groundwater conservation measures. By expanding knowledge of the relationship between groundwater pumping and energy use, the project will enhance the ability of the State of California and irrigation and drinking water districts to coordinate water and energy resources planning. In addition, the project is providing key insights on how to improve groundwater use and pumping efficiency.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This study is quantifying current and near-term statewide energy use and costs due to groundwater pumping. Previous estimates of energy use for groundwater pumping likely underestimated the amount of energy used because of a lack of good information on actual groundwater use. Due to recent regulatory changes, the availability of information on groundwater use has increased significantly. This information, combined high resolution	

modeling of hydrologic and climate change effects will allow the researchers to produce more accurate estimates of current and future energy used for groundwater pumping. Benefits from this study will enable entities, such as investor owned utilities, water agencies and others to increase the efficiency of the energy used in the water sector, inform demand side management strategies, and decrease greenhouse gas emissions.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 2a, 4c

Greater Reliability:

This study is quantifying current and near-term future energy use and costs for groundwater pumping. This will inform water-energy planning throughout the state, increasing grid reliability. The study will also inform conservation efforts to reduce groundwater use which not only saves water, but reduces energy demand and intensity.

One estimated benefit is that proper planning and conservation, such as reducing the pumping of groundwater in urban areas, 0.6 million acre feet of water could be saved per year. This reduction in pumping could lead to an annual savings of 120 gigawatt hours.

Environmental Benefits:

The team is also exploring institutional, economic, informational and social barriers to decreasing the energy intensity of groundwater pumping. This will facilitate the implementation of energy and water conservation strategies which will provide environmental as well as reliability and cost benefits.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $260,000	
EPIC Funds Encumbered: $625,000		**EPIC Funds Spent:** $530,408	
Match Partner and Funding Split: Michael Hanneman: $22,550 (3.5 %)		**Match Funding:** $22,550	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 7: Ranked # 1

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project is in progress and is continuing to collect data on groundwater pumping and electricity use. A technical advisory committee meeting was held in November, 2018 to identify additional data sources. Data collected for this project so far has been limited with significant gaps and inconsistencies. Therefore, recent efforts have focused on addressing these deficiencies while continuing to collect data from agricultural and other large scale groundwater users. Hydrologic modeling of groundwater changes in the state's Central Valley to supplement data gaps and allow simulations of future groundwater and associated energy demand continues. Due to these data collection difficulties, delivery of technical deliverables due in late 2018 have been delayed. Significant effort will need to be complete the project by the contract end date in June of this year.

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Project Name:

Probabilistic Seasonal and Decadal Forecasts for the Electricity System Using Linear Inverse Modeling

[EPC-15-036]

Recipient/Contractor:

Eagle Rock Analytics

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/13/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

As California moves towards a diverse energy future, with a focus on renewables, the need for improved weather/climate forecasts will increase. These forecasts/scenarios are needed at the seasonal and decadal scales to address operational and planning issues.

Project Description:

The research team developed and tested new forecast methods for temperature and humidity and extensive testing is taking place. The forecasts will be provided in the format used by energy planners and managers. The researchers are exploring the forecasting utility of parameters such as sea surface temperatures in the middle of the Pacific Ocean that can influence summer conditions in California months in advance. The decadal forecasts will be done using forecasts of large-scale predictor variables of climate from different research centers downscaled to the California region.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is unique in its use of sea surface temperatures to create a probabilistic forecast of long-term weather conditions in California. The project aims to determine, for example, the likelihood of California experiencing consecutive days above 105 degrees F in a given year.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 5c
Greater Reliability:
Improved information about potential weather conditions in the next few months (probabilistic seasonal forecasts) can help plan for unusual weather conditions such as summers with much higher than average high temperatures. The CaISO uses climatology (average weather conditions) to estimate the generating capacity that will be needed for the summer. Improved seasonal forecasts have the potential to anticipate summers with very hot days and ensure enough generation is secured to handle high peak demand.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$26,898</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$400,000</td><td colspan="2">EPIC Funds Spent:
$277,623</td></tr>
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N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
45 out of 45 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 10: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The research team is on track to deliver an operational seasonal forecast model based on Linear Inverse Modeling in early 2019. The team has begun translating the underlying code for compatibility with Cal-Adapt so that it is amenable to integration with this publicly available, interactive, and easy-to-use platform. Additionally, based on input from utilities engaged through the Technical Advisory Committee, the research team has elicited the variables and types of predictions that they are most interested in, namely seasonal temperature predictions (done), changing shape of diurnal (hourly) temperature curves, and</td></tr>
</table>

winter season hydrology. Accordingly, the research team is exploring the ability of their model to further resolve seasonal temperature predictions in a manner that sheds light on the latter two considerations.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Smart Ventilation for Advanced California Homes

[EPC-15-037]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/13/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

As California approaches zero net energy (ZNE) homes, heating and cooling loads and systems get smaller, but the need to provide acceptable indoor air quality (IAQ) remains unchanged. Business as usual will result in ventilation contributing a larger fractional load, which counters ZNE goals. In addition, current approaches that specify ventilation per hour are not responsive to occupant needs or contaminants of concern levels.

Project Description:

This project develops approaches and tools to enable smart ventilation techniques suitable for new and existing advanced and ZNE homes. Smart ventilation systems use information about current thermal, occupancy, system, and air quality conditions to optimize performance of ventilation-related equipment.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This work builds on efforts of the past decade that have facilitated dynamic ventilation approaches. The project uses informed simulation approaches to determine how energy, IAQ, demand, and comfort can be optimized using smart ventilation. The results from the project will help consumers identify effective smart ventilation strategies and provide important information that advises the Energy Commission in development of ventilation standards.

CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Applicable Metrics: CPUC Metrics- 4b, 5d

Lower Costs:

The project will result in reduced electricity consumption by using smart ventilation strategies to optimize the ventilation system performance. The system will collect indoor and outdoor air quality and environmental data to adjust ventilation strategies to minimize electricity consumption and maintain adequate IAQ.

Public Health:

The project recommends smart ventilation technologies to benefit ratepayers to obtain energy efficiency saving and maintain proper ventilation for their homes. The smart ventilation strategies will provide real-time optimization of outdoor air supply, reduce the indoor pollution levels.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $649,037
EPIC Funds Encumbered: $1,500,000	**EPIC Funds Spent:** $741,240
Match Partner and Funding Split: United States Department of Energy: $1,000,000 (35.7 %) Aereco S.A.: $200,000 (7.1 %) Lawrence Berkeley National Laboratory: $100,000 (3.6 %)	**Match Funding:** $1,300,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

Terms and Conditions.
Update: The research team completed the literature review of smart ventilation, resulting in a few journal publications. The team also developed a guideline for indoor air quality (IAQ) metrics. These metrics have now been used in a Department of Energy project in the development of a home IAQ scoring system. The key technical work for this project is to develop an integrated energy simulation model that includes smart ventilation technology. The simulation work is expected to start in 2019. The team also developed a range of optimized control algorithms for various home ventilation scenarios based on occupancy, timers, and weather conditions.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

BlueTechValley Innovation Cluster

[EPC-15-038]

Recipient/Contractor:

California State University, Fresno Foundation

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan 2015-2017 Triennial Investment Plan	5/16/2016 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development

Market Facilitation

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies
S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

While Central Valley entrepreneurs are helping to drive new and effective energy and water innovations, many are still limited by technical and non-technical hurdles on the road to commercialization. On their own, many do not have sufficient resources to fully test their technologies, develop fundable business plans, grow entrepreneurial networks, or transition technologies from trial or demonstration scale to real-world deployment and commercialization. The need to help such entrepreneurs is magnified by the recent drought conditions in the Central Valley that have critically reduced available surface water supplies and increased electricity demand due to increased groundwater pumping.

Project Description:

This project expands access for clean energy entrepreneurs to a region-wide energy-water-food nexus incubator and commercialization services in California's Central Valley and North State regions. The Central Valley Energy Innovation Cluster (a.k.a. BlueTechValley (BTV) Energy Cluster) provides entrepreneurs with a variety of services, including technology evaluation, proof-of-concept validation and advisory support as well as opportunities to connect with investors, industry leaders and potential customers.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will help lead to technology advancements by providing and coordinating key services, assistance, resources, and infrastructure needed by entrepreneurs and researchers

<table>
<tr><td colspan="4">to create and develop advanced energy technologies that will help the state meet the targets set by Senate Bill 350 to increase both renewable electricity generation and energy efficiency to 50 percent by 2030.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Water-Energy Nexus: R.13-12-011 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 3e
Economic Development:
This project helps facilitate successful clean energy entrepreneurship, leading to increased private sector investment and local job creation.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$718,347</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$5,000,000</td><td colspan="2">EPIC Funds Spent:
$558,551</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
California State University, Fresno Foundation: $2,350,112 (30.7 %)
Child Family Institute for Innovation and Entrepreneurship - UC Davis: $200,000 (2.6 %)
Schatz Energy Research Center: $35,772 (0.5 %)
Los Angeles Cleantech Incubator: $19,900 (0.3 %)
Kern Economic Development Corporation: $49,900 (0.7 %)</td><td colspan="2">Match Funding:
$2,655,684</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
6 out of 12 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

As of 2018, BTV has accepted and supported 113 companies into their program (57 companies in 2018), and these companies have received $13.9 million in additional private capital funding and $600,000 in additional public funding in 2018, with one company receiving $30 million in project financing.

BTV has hosted or supported more than 54 events in 2018, which ranged from recruiting and supporting companies, to promoting the BTV program.

In early 2019, BTV outreach will focus on a few key areas. First, to strengthen connections with Hubs through site visits, attending events, and enlisting program ambassadors to network and promote BTV services. Second, to conduct events at each Hub to help entrepreneurs develop their business with events ranging from startup boot camp to legal issues to grant writing. Third, to work with the Hubs to grow the offering of online resources.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle

[EPC-15-039]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/24/2016 to 8/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Deserts are impacted by both the development of large scale solar installations, and by the temperature changes associated with human induced climate change. The effect of these impacts on the soil organic (biomass) and inorganic (calcium carbonate) carbon budget is unknown. ">It is crucial to gain quantitative understanding whether desert ecosystems will lose carbon as a result of both solar field installations and climate change, as well as to identify the environmental costs and benefits of renewable energy development in terms of greenhouse gas (GHG) emissions.

Project Description:

This project installs soil and meteorological sensors at sites with solar installations and in adjacent undisturbed areas to make direct comparisons on the gains or losses of carbon, changes in microclimate and hydrology, changes in dust generation or capture, aiming to predict long term soil and GHG emissions changes based on geochemical modeling. The project addresses the question of whether land alteration and modification during the construction and use of solar installations has a measurable impact on the soil carbon balance, and ultimately on the net carbon savings that solar installations provide during their lifetime.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The research project is for the first time determines the impact of large solar arrays on the carbon storage of desert soil ecosystems. Findings will provide insights into the most effective ways to design and manage solar production facilities for maximum net carbon benefits.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 2a, 4f

Lower Costs:

The proposed research estimates the mass (and market-based value) of net carbon change in desert soils due to solar sites development and climate change. These metrics for soil carbon gains and losses could be incorporated into renewable energy credits (RECs) and would constitute a direct monetary benefit to California IOU ratepayers.

Environmental Benefits:

The proposed research estimates GHG emissions arising from net changes to the natural soil carbon cycle caused by utility scale solar installations, reduces regulatory uncertainty, and facilitates more efficient environmental approval procedures for solar energy companies, which helps to meet the state's renewable energy goals.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$80,312
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$499,181	$31,720
Match Partner and Funding Split:	**Match Funding:**
SunPower Corporation: $72,000 (12.6 %)	$72,000
Leverage Contributors:	**Leveraged Funds:**
N/A	$0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	45 out of 45 bidders	Group 4: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Terms and Conditions.
Update: The research team has completed sensor installation at the six sites in Mojave Desert and they are collecting real-time meteorological data and CO2 flux data. The team continued soil sampling in soil trenches excavated at each of the six sites. Completed physical and chemical soil analyses will include: soil water retention curves, soil porosity, soil water permeability functions, organic C/N content and isotopic composition, carbonate content and isotopic composition, and radiocarbon dates. Throughout 2018, the research team collected data from six reference sites in the Mojave Desert and started data collection at solar PV facility site. In early 2019, the team will evaluate short- and long-term impacts of land use and climate change on the soil carbon cycle in arid areas.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Assessing California's Mitigation Guidelines for Burrowing Owls Impacted by Renewable Energy

[EPC-15-040]

Recipient/Contractor:

Zoological Society of San Diego dba San Diego Zoo Global

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/24/2016 to 9/2/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

In California, western burrowing owls (*Athene cunicularia hypugaea*) have been designated with the conservation status of Species of Special Concern, mainly due to habitat loss. With planned facility expansions in burrowing owl habitat, renewable energy projects potentially represent a major contributing factor in the continued decline of the species. Translocation away from project sites is an important mitigation method for owls impacted by development, but there is significant uncertainty around the effectiveness of the main two approaches (active and passive translocation) due to the difficulty of tracking owls long enough to determine post-translocation fates.

Project Description:

The project studies and tests the consequences of both passive and active relocation methods for burrowing owls (a California Species of Special Concern), and fills an existing need for robust scientific data on the relative effectiveness of relocation as a conservation method. Secondary goals are to provide data on owl movements and habitat use that can inform collision risk models and site selection decisions for renewable energy-generating facilities. The project team has fit more than 50 owls with GPS tracking devices and dividing them into three study groups--active translocation, passive relocation, and a control group. Frequent site visits are providing information on mortality rates and reproductive output.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on burrowing owls. This will be achieved by evaluating the relative effectiveness of primary translocation methods in an experimental framework. Improvements to the effectiveness of existing translocation methods will also be tested experimentally.

Long-term GPS tracking of individuals in the active and passive relocation groups and a control group is providing the critical, previously missing, information to judge the effectiveness of each method. The management recommendations and proposed translocation protocols from this study should improve the success of mitigation and facilitate new permitting of renewable energy.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4f, 4g

Environmental Benefits:

The project will identify the most effective method for translocation of burrowing owls that are displaced from renewable energy development areas. This should lead to better guidelines for mitigating impacts on this California Species of Special Concern. The project is producing management recommendations to the wildlife regulatory agencies to improve the success of owl translocations.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $54,425
EPIC Funds Encumbered: $598,671	**EPIC Funds Spent:** $335,856
Match Partner and Funding Split: Western Riverside County Regional Conservation Authority: $127,315 (10.6 %) United States Department Fish and Wildlife Service: $35,022 (2.9 %) Zoological Society of San Diego dba San Diego Zoo Global: $407,161 (33.9 %) Coachella Valley Conservation Commission: $33,438 (2.8 %)	**Match Funding:** $602,936
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 6: Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: By the end of the second season, the research team has captured the targeted number of burrowing owls at development sites for the three treatment groups. They have released the active translocation group of owls at conservation areas. They have monitored the mortality and reproductive success of these owls. In collaboration with their technical advisory committee, they have refined the study design and research protocols and will be making recommendations to wildlife regulatory agencies about translocation protocols. In addition, they have tested GPS units and modified their design for use with burrowing owls. The team shared sample material from captured owls with researchers in EPC-14-061 and EPC-15-043 to extend the data used for isotopic and genetic analyses in those projects.

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Project Name:

MarketZero: Taking an existing grocery store to scalable near-ZNE

[EPC-15-041]

Recipient/Contractor:

Prospect Silicon Valley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Supermarkets and grocery stores have the highest energy use indices of commercial building types. They are also the most challenging cases to achieve zero net energy among commercial buildings. This is due to the high process energy use of refrigeration and commercial kitchen systems. The 2006 California Commercial End-Use Survey (CEUS) indicated a statewide average use of approximately 210 Kbtu/SF/yr in existing grocery stores.

Project Description:

The project implements a cost-effective energy efficiency upgrade package for a grocery store that uses both mature efficiency technology and new innovative technologies. The project includes LED lighting and refrigeration system improvements to increase energy efficiency, changing to a lower global warming potential refrigerant (R448A), and installing high-efficiency variable frequency drive compressors. Other improvements include thermal ice packs in the walk-in freezers to reduce compressor run time during the day and help shift electrical load on hot days, variable speed reluctance motors for the supply fans for new efficient heat pumps, emerging nelumbo coatings for the evaporator coils for self-contained refrigeration cases to improve the efficiency.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

As grocery stores are risk averse especially with new emerging innovative technologies, successful demonstration showing the benefits and performance has the potential to advance these technologies to other stores. As profit margins for grocery stores are between 1 and 3 percent, increases in energy efficiency using these advanced technologies will be beneficial to a store's bottom line. Also, these types of improvements pose challenges to grocery stores due to limited space and existing configurations. However, documenting cost, savings and benefits could influence the grocery market to make similar future upgrades. These solutions and design approaches hope to achieve near zero net energy for a grocery store.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 4a

Lower Costs:

Lower Costs: Implementing the energy efficiency upgrade package could lower future energy costs for building owners and operators and is applicable to other grocery stores. Estimated state-wide reduction of about $400 million (based on savings of 2,400 GWh and 15 million therms) across California grocery stores.

Environmental Benefits:

Implementing the measures could reduce resource consumption (energy, water), reduced greenhouse gas emissions, while improving indoor air and environmental quality.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $846,723
EPIC Funds Encumbered: $2,999,591	**EPIC Funds Spent:** $794,134
Match Partner and Funding Split: Whole Foods Market: $650,000 (17.8 %)	**Match Funding:** $650,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 39 out of 39 bidders	**Rank of Selected Applicant/ Bidder:** Group 5: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The final list of energy efficiency measures to be installed was approved by the CAM. Staff visited the Whole Foods Store in San Francisco in October 2018 and obtained information on the retrofit strategy for the store. The overall project is moving forward and remains on track for all energy efficiency measures to be installed by the end of March 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Zero Energy Residential Optimization - Community Achievement (ZERO-CA) [EPC-15-042]	
Recipient/Contractor: California Homebuilding Foundation (CHF)	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/1/2016 to 3/31/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development	
Issue: Although the construction of a number of single (one-off) Zero Net Energy (ZNE) homes has established that this is a technically feasible goal, it is less clear whether ZNE construction can cost-effectively be brought to scale, especially within the context of the Title 24 Building Energy Efficiency Standards. There is a need for significant increase in the efficiency of California new construction - without significant increases in cost. Additionally, the State will need improved methods for estimating and controlling the unregulated loads, which have grown and will continue to grow over the coming decades.	
Project Description: The project serves as proof of concept for large-scale deployment of Zero Net Energy (ZNE) single-family homes in California. The objective is to construct ZNE homes without creating undue cost burdens on builders, businesses or consumers, while assuring that changes to home design do not pose health, safety or other risks to occupants. The project also provides industry and regulators with a better understanding of site energy use and renewable energy generation.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Working closely with the builder and subcontractors, technology costs will be evaluated and will include a real-world perspective by providing actual time and labor spent to install and commission each of the new technologies versus only the technology cost. By providing this data and analysis on the approximate 50 homes being constructed, this project will serve as a roadmap toward the most effective ways to implement ZNE homes. The information	

gathered will be disseminated through various project participants such as California Building Industry Association (CBIA) events and member newsletters in efforts to promote the potential for cost-effective ZNE to the builder community.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 3b, 4a

Lower Costs:

The project will focus on cost control for ZNE construction by developing cost-effective packages of measures that include both commercially available and emerging technologies that meet the requirements of the Building Energy Efficiency Standards (Title 24, Part 6) as well as unregulated measures. Examples of unregulated measures include appliances, and plug load. In addition to builder cost savings passed to consumers in sales price, the project will assess and optimize actual consumer utility cost savings from ownership of ZNE homes.

Environmental Benefits:

This project is estimated to reduce greenhouse gas (GHG) emissions by integrating renewable energy and other energy efficiency measures into at least 50 homes within a community development project. This offset of end-use demand will result in an avoided capacity needed at the generation level and the reduction of GHG emissions associated with that demand.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $1,488,701
EPIC Funds Encumbered: $4,819,805	**EPIC Funds Spent:** $1,139,277
Match Partner and Funding Split: California Homebuilding Foundation (CHF): $2,611,014 (35.1 %)	**Match Funding:** $2,611,014
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	39 out of 39 bidders	Group 6: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has started construction on the first phase of ZNE Homes. A ZNE analysis report that provides an assessment of the relative cost-effectiveness of various prescriptive and above-code energy efficiency measures that can help drive California residential construction towards achieving ZNE was completed. The team is currently finalizing details for the monitoring and verification system that will be implemented. Portions of the monitoring has begun such as monitoring attic conditions to understand thermal performance and potential for moisture-related risks for air-permeable insulation systems in unvented attics. Additional measures are still being explored for energy savings such as home energy management systems and battery storage.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Development of a Genoscape Framework for Assessing Population-Level Impacts of Renewable Energy Development on Migratory Bird Species in California

[EPC-15-043]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/3/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

While renewable energy facilities offer clean alternatives to our growing energy needs, they have recently come under scrutiny for their impacts on native wildlife. In particular, tens of thousands of protected birds are killed at solar and wind facilities each year. Assessment of the overall impact of these facilities has been hampered because 1) population-level distributions are poorly understood (i.e. do killed individuals come from vulnerable populations?) and 2) current methods for identifying migration routes have low resolution and are extremely costly.

Project Description:

This project develops a low-cost method that capitalizes on genomic data to create high-resolution spatial maps of bird populations and migration routes. This technology will be extended to identify migration routes for additional vulnerable and endangered species, assess population-level impacts of fatalities at renewable energy facilities, and map migration hotspots. This information will help with siting decisions of new facilities as well as operational decisions, such as when to turn off wind turbines to avoid vulnerable population fatalities, reducing the overall number of bird losses at renewable energy facilities. Accurate understanding of the distributions of vulnerable populations in space and time will lead to more effective siting, monitoring, and operation, ultimately lowering costs to California ratepayers.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project harnesses the power of genomic data to develop genetic assays for quick, low cost screening of thousands of individuals. Researchers are creating high-resolution maps of population structure and migration routes and applying this information to assess population-

level impacts by screening carcasses collected from renewable energy facilities. Genoscape maps are being merged with existing spatial data of energy potential to make recommendations for siting new facilities in areas with minimal impact on wildlife.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4g

Environmental Benefits:

Improved mapping of migration routes of bird populations of concern and their timing will inform renewable energy siting decisions by solar and wind developers and help them target mitigation strategies.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$114,850
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$599,236	$436,022
Match Partner and Funding Split:	**Match Funding:**
Regents of the University of California, Los Angeles: $888,250 (59.7 %)	$888,250
Leverage Contributors:	**Leveraged Funds:**
N/A	$0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	45 out of 45 bidders	Group 6: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

The research team has collected samples for the selected set of birds (Common Yellowthroats, Burrowing Owls, and American Kestrel plus others being studied with match funds) and completed genetic analysis to map distinct populations. Some of the Burrowing Owl samples were obtained from EPC-15-040. In Fall 2017, the researchers developed maps and schedules of the migration routes (genoscape maps) relative to renewable energy sites. They collected samples from bird carcasses killed at solar and wind facilities (some obtained from EPC-14-061) to use the genetic methods to determine the population to which the dead birds belonged to estimate the population-level effects. They have developed their approach for prioritizing migratory hotspots with input from the TAC and others. Multiple journal articles are being written.

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Project Name: Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources [EPC-15-044]	
Recipient/Contractor: Electric Power Research Institute, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 8/15/2016 to 3/29/2019
Program Area and Strategic Objective: Applied Research and Development S7: Develop Operational Tools, Models, and Simulations to Improve Grid Resource Planning	
Issue: Revisions being made to Rule 21 require grid-supportive functionality and communication interfaces, and the revisions specify the IEEE 2030.5 communication protocol for monitoring and managing distributed energy resources (DER). This protocol is complex, making the development of products difficult and putting interoperability at risk. The application of the IEEE 2030.5 protocol to DER is new, and certification procedures and test software for this application do not exist. These challenges translate to delays in the availability of products and programs that provide grid support opportunities, which prevents owners of DERs to realize additional value of their asserts from grid services.	
Project Description: This project developed two key open-source software technologies: 1) implementation of a complete, certified IEEE 2030.5 communication protocol that manufacturers can freely incorporate into their products. This reduces the cost and complexity of bringing systems to market, streamlines the certification process, and helps ensure that products can successfully connect and participate in grid programs; and 2) a certification procedure and associated test software by which any system or device can be checked for compliance to the standard. Independent evaluation provides manufacturers with an unbiased assessment of their products and provides both business and individual consumers with assurance that their purchases will work as expected. The project also validated the completeness and quality of these technologies by implementing the open-source client in a commercial DER system and performing field testing.	

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How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project helps accelerate availability and connection of DER products and systems in California that meet Rule 21 requirements. This will also help more rapidly increase grid-tied solar generation to meet California's aggressive solar mandates.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1a, 1h, 1i, 2a, 3a, 5a

Lower Costs:

The cost of product development and system integration is reduced through the availability of free open source software. These cost savings are reflected in retail costs and program incentives that directly benefit California ratepayers. The recipient estimated that the open-source software will enable $1-2 million of cost savings per DER manufacturer by eliminating the need to develop, test, integrate and certify proprietary software.

Consumer Appeal:

Customers of all types want solar to be easy to install and connect, which requires their investments to be compatible with utility communication systems.

Energy Security:

Emergency backup power and smart home systems that aid consumers during disasters become practical because of the accessibility and interoperability of systems provided by a successful open communication protocol.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Distribution	$203,973
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$816,539	$523,523
Match Partner and Funding Split:	**Match Funding:**
Electric Power Research Institute, Inc.: $92,153 (8.7 %) Enphase Energy: $24,000 (2.3 %) QualityLogic: $32,519 (3.1 %) SunSpec Alliance: $65,050 (6.1 %) Xanthus Consulting International: $30,000	$243,722

<table>
<tr><td colspan="2">(2.8 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
23 out of 29 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The EPRI team developed the first free, open-source client software of the IEEE 2030.5 communication standard for DERs. This software enables manufacturers to deliver the next generation of intelligent DER devices and systems. Moreover, the project also developed the test procedure and the associated test software by which DERs can be checked for compliance to the IEEE 2030.5 standard. The project team overcame several challenges including late release of IEEE 2030.5 to deliver these key technologies to the state of California. The open source software has been integrated in a commercial DER gateway and was successfully tested at an Enphase laboratory.</td></tr>
</table>

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Project Name: Transactive Incentive Signals to Manage Electricity Consumption for Demand Response [EPC-15-045]	
Recipient/Contractor: Electric Power Research Institute, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/18/2016 to 6/28/2019
Program Area and Strategic Objective: Applied Research and Development S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices	
Issue: Demand response (DR) has substantial potential to act as either a demand-side or a supply-side resource. However, existing programs and rates do not provide a participation incentive structure that accurately reflects system conditions or system costs, a suboptimal situation that results in higher ratepayer costs, low DR participation and an inability for system operators to regularly utilize demand-side resources. As the state moves toward more distributed generation and intermittent renewable energy generation, integration of those generation resources will further increase costs in the absence of significantly expanded DR resources responding to actual system needs in real time.	
Project Description: This project develops Transactive Load Management (TLM) signals, expressed in the form of proxy prices reflective of current and future grid conditions, and develops and implements software to calculate such signals. These signals are being designed to provide customers sufficient information to optimize their energy costs by managing their demand in response to system needs. The signals are transported via proven and available protocols and networks for use by projects that will test the efficacy of the TLM signals using the demand response projects awarded under GFO-15-311, Advancing Solutions that allow Customers to Manage Their Energy Demand.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project has developed a day-ahead hourly proxy price signal that incorporates system conditions as reflected by wholesale energy markets. The hourly prices are being made available on a publicly-accessible server and are being incorporated as one of the experimental pricing structures being evaluated in EPIC demand response projects funded under GFO-15-311 in order to assess the potential for a variety of different loads and	

customer types to respond automatically to a real-time proxy pricing signal, and by extension, the potential of DR being a demand side or a supply side resource for the State.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 [closed] Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1f, 1g, 1h, 3c, 3e, 3f, 3h, 4a, 5a, 5b

Lower Costs:

Demand response lowers costs for both the system and individual customers. Procurement costs are reduced when wholesale energy prices are attenuated by price-responsive demand; customer costs are reduced when they either shift consumption to lower-priced times or receive payment for participating load reduction.

Greater Reliability:

High levels of demand can stress grid assets, and increased stress could lead to outages if left unchecked. To the extent that a TLM signal and smart management of consumer loads can minimize stress on grid equipment, reliability is improved.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $126,585
EPIC Funds Encumbered: $498,054	**EPIC Funds Spent:** $259,071
Match Partner and Funding Split: Greenlots: $110,450 (18.2 %)	**Match Funding:** $110,450
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	19 out of 21 bidders	Group 3: Ranked # 1
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: The project is on schedule and will be completed in the first Quarter of 2019. The reference design for the Transactive Load Management signal was implemented in early 2018 and has been providing the 24-hour ahead real-time signal continuously since then. All interim deliverables have been received and the draft Final Report is expected January 30, 2019.			

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Project Name: Developing a Distribution Substation Management System [EPC-15-046]	
Recipient/Contractor: Siemens Corporation	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/24/2016 to 3/29/2019
Program Area and Strategic Objective: Applied Research and Development S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020	
Issue: As the electric distribution system becomes increasingly complex with the integration of more distributed energy resources, existing distribution automation systems need to be enhanced with functions to manage increasing amounts of renewable energy connected at the distribution level and to provide greater control over the operation of distributed energy resources. Distribution management systems need to automate more monitoring and control operations at substations using standard communication protocols to quickly respond to changes and problems to reduce outage times.	
Project Description: This project is developing a software which will show the current state of the distribution system, detect problems, and automatically suggest potential solutions to reduce outage times. The software also helps automate routine and non-routine engineering and maintenance tasks that are performed on substation equipment, such as monitoring voltage violation.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Highly automated and efficient grid operation is required to achieve California's energy goals, in particular with respect to the Clean Energy and Pollution Reduction Act of 2015 (Senate Bill 350) that strives to reach 50 percent renewable energy resources. This project will lead to technological advancement and breakthroughs to overcome barriers in electrical grid automation by demonstrating the potential of semantic technologies for categorizing and processing data, as well as for discovering relationships within a varied data set. This system will allow operators to control and further automate routine and non-routine engineering and maintenance tasks that are performed on substations. By making the complex smart grid	

<table>
<tr><td colspan="4">more accessible for operators, it will permit faster resolution of outages, thereby making the grid more maintainable and resilient.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 3a, 3d, 5f, 5h
Lower Costs:
A greater degree of automation for grid operation processes will lead to reduced grid operation costs that potentially translates into lower rates for California ratepayers.

Greater Reliability:
The main benefit of this project is that it will allow certain grid problems to be resolved automatically, thus reducing power outages.

Energy Security:
A greater degree of grid automation enables faster reactions to shifts in electricity production, thereby permitting a higher percentage of distributed renewable energy resources.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Distribution</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$171,526</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$500,000</td><td colspan="2">EPIC Funds Spent:
$309,024</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Siemens Corporation, Corporate Technology: $455,000 (47.6 %)</td><td colspan="2">Match Funding:
$455,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
23 out of 29 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 3</td></tr>
</table>

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The Siemens team completed software development and added new functionalities this year. The system is now able to detect anomalies and download, install and configure a specific piece of software or app to fix the problem detected on a faulty substation. The team also built an augmented reality application that allows grid operators to have an immersive experience with a global view of a cluster of substations. The system allows operators to visualize the operating status of the substation, issues that arise, and status of fixes for the issues. All the technical tasks of this project are completed. The project concludes in March 2019.

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Project Name:

Powernet - A Cloud Based Method for Managing Distribution Resources

[EPC-15-047]

Recipient/Contractor:

SLAC National Accelerator Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/18/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

The power grid is changing rapidly. In California, renewables on the utility side of the meter are expected to provide 50% or more of the load by 2030, requiring significant distributed energy resources (DERs) to help integrate those renewables. Additionally, greatly expanded numbers of DERs, such as distributed solar, storage, and EVs, are expected on the customer side of the meter and on the utility side of the distribution grid. There is an urgent need to coordinate all these resources to minimize costs, increase consumer quality of service, preserve grid stability and offer services to the grid.

Project Description:

This project will further develop Powernet, a cloud-based method to manage energy resources in homes and businesses. Powernet will control and coordinate energy resources both behind the meter and at the distribution system for residential and commercial ratepayers to: (i) minimize costs, (ii) increase consumer quality of service, (iii) preserve grid stability and (iv) offer services to the grid.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Several significant Powernet system innovations will be developed under this agreement: (i) The integration of control, optimization and power electronics will enable novel functionality that includes stable connect/disconnect from the grid, local and global power sharing, and grid services including demand response; (ii) The layered structure of the system will enable the operator to utilize Powernet for a variety of different grid purposes or service offerings with the assurance that those are always done on top of an economically optimal operating point every second; (iii) The system will be robust and secure by design; and (iv) The system will adopt open source standards and protocols for the platform to enable scalable engagement of devices in the future.

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CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1g, 2a, 3a, 3d, 3f, 5f, 5h

Lower Costs:

There will be economic savings to using Powernet. Every home and business will need to pay only once for installation of the Powernet and can then progressively add DERs on its own. While balance of systems cost of storage and solar can reach 65% of of the total ownership cost, this may be reduced to 50% to 55% using Powernet depending on the total number of DERs installed.

Greater Reliability:

Powernet will allow for greater control of a diverse set of behind-the-meter resources, which will enable greater reliability of the grid.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $865,939
EPIC Funds Encumbered: $2,210,720	**EPIC Funds Spent:** $1,794,391
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: United States Department of Energy: $3,500,000	**Leveraged Funds:** $3,500,000

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 23 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

Terms and Conditions.
Update: The project team made progress in the following areas: 1) identified a new site location when the previous site backed out, 2) developed a simulation platform that can accommodate up to 10K houses and includes detailed models of the cloud coordinator and markets; 3) evaluated the behavior and the performance of the system when controlling demand response of the appliances and devices in the houses; 4) developed, constructed and began tests in the lab of the residential battery energy storage system, residential roof top solar, electric vehicle charging stations and household appliances; and 5) continued finalizing the software and hardware architecture for the technologies that are going to be deployed in the participating homes.

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Project Name:

Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources

[EPC-15-048]

Recipient/Contractor:

Alternative Energy Systems Consulting, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

Excessive variable solar generation during the daytime is challenging for grid operators due to the steep ramp up and down in the morning and evening. Significant contribution from renewables cannot be realized unless there is a transformation of how energy is being managed, especially as the electrical grid moves more towards a complex mesh of millions of distributed generators. An effective solution for integrating distributed generators with energy storage, managing loads, and utilizing excess production during periods of peak generation is needed.

Project Description:

This project tests and validates an intelligent residential energy management system that is capable of communicating with a variety of distributed energy resources (DER) including solar PV and energy storage in 100 residences in San Diego. The project integrates the use of pilot time-of-use utility rates in conjunction with simulated dynamic pricing signals to optimize grid impact and cost savings.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The key advancement in this project will be the operational integration strategies being developed and tested in the field. If proven successful through field testing, this system has the potential of achieving widespread deployment throughout the state which could significantly reduce peak demand, reduce annual energy costs, and improve grid operations.

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CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1e, 1h, 2a, 4a

Lower Costs:

Based on initial estimates, implementation of the energy management system could reduce annual customer electricity costs by 36 to 41 percent by enabling residents to use the majority of their electricity when energy rates are the lowest.

Greater Reliability:

The integration and communication of distributed energy resources across millions of homes can provide greater electricity grid flexibility, which allows greater renewable penetration while reducing outage risk.

Environmental Benefits:

A solution that enables ratepayers/customers to use higher levels of renewable energy generation will help reduce GHG emissions.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $938,190
EPIC Funds Encumbered: $3,996,560	**EPIC Funds Spent:** $2,174,231
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 21 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Progress this year includes finalizing the pilot test design, recruiting 100 test participants, getting stakeholder feedback through technical advisory meetings, and completing pilot test home installations. Other activities underway include ongoing commissioning at test sites, and initiating data collection activities. As of December 2018, all installations at the 100 test sites have been completed. Energy Commission staff conducted a site visit to San Diego in December 2018.

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Project Name:

Winery Water and Energy Savings

[EPC-15-050]

Recipient/Contractor:

Regents of the University of California, Davis

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 12/31/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California is the fourth largest producer of wine in the world. The California wine industry is a significant water consumer and is the second largest consumer of electricity among the food and beverage industry. As the wine industry and its associated water and energy use continue to expand, efficiency technologies will become increasingly important. Water supply is limited and energy bills will become a larger portion of operating costs if not contained. Water reuse and novel heat recovery can significantly decrease fresh water use in wine production while decreasing energy use, but data on technical and economic feasibility is limited.

Project Description:

This project is testing two energy and water saving technologies at a winery facility in northern California. The first technology is a water treatment and reuse system to recycle wastewater for indoor barrel washing. The second is a wine-to-wine heat exchanger for the cold-stabilization process -- a process through which white wine is cooled to a low 28 degree Fahrenheit and then heated back up to 55 degree Fahrenheit. Both technologies are to be installed on a single skid at the project location in Sonoma County, along with monitoring and verification equipment. Jackson Family Wines owns the bottling facility where the technologies are being tested.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project focuses on full-scale technology demonstrations of two water and energy saving technologies for the wine industry. The water treatment and reuse system uses reverse osmosis to treat water to potable standards for barrel washing with an estimated water

savings of 90 percent at the facility. The second technology is an innovative wine-to-wine heat exchanger for the cold-stabilization of the white wine that reutilizes the thermal potential of existing cooling and heating streams which reduces the amount of energy used for processing white wine.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 2a, 4a, 4c

Lower Costs:

Water and energy savings are expected to reduce energy bills, leading to lower operating costs for winemakers and owners of bottling plants. Treating and reusing barrel wash water results in additional energy savings by reducing electricity costs associated with pumping water from wells. Furthermore, the wine-to-wine heat exchanger technology for the cold-stabilization of wines offers significant electricity and natural gas savings. The estimated overall annual energy cost savings for this project is $54,418.

Environmental Benefits:

This project is estimated to reduce the amount of fresh groundwater used for barrel washing by 90 percent annually. Reuse of the treated wastewater for barrel washing is expected to save 1.4 million gallons of fresh water annually. In addition, the wine-to-wine heat exchanger technology can result in energy savings and greenhouse gas emissions reduction. The annual greenhouse gas emissions reduction for the overall project is estimated to be 504,111 pounds of CO2e, based on electricity, natural gas, and water savings.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $157,088
EPIC Funds Encumbered: $1,989,201	**EPIC Funds Spent:** $871,323
Match Partner and Funding Split: Jackson Family Wines: $404,625 (16.9 %)	**Match Funding:** $404,625
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 35 bidders	Group 2: Ranked # 5

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Name: Vibratory Shear Enhanced Processing (VSEP). **Type:** Project-relevant pre-existing IP - Technology, Design, Drawing. The proprietary technology was fully developed and patented by the owner, New Logic Research Inc., prior to the start of this Agreement. Name and date of Copyright and Patent to be provided.

Update:

The water treatment and reuse and the wine-to-wine heat exchanger systems have been installed and commissioned and a full-scale demonstration began October 2018. The project team developed a Measurement and Verification Plan and has begun a 12-month measurement of the water and energy savings for both the water treatment and reuse system, and the wine-to-wine heat exchanger.

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Project Name:

The Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings

[EPC-15-051]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 6/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

Advanced lighting controls are among the rapidly evolving technologies that utilize wireless communications, sensors, data analytics and controls to optimize building systems in real time. Energy benefits due to lighting controls are becoming a smaller piece of the value proposition because the cost savings are smaller due to the higher efficiency of LED lighting. Though lighting represents a significant potential demand response (DR) resource, the value and benefits it can offer to the electric grid and to customers is not well understood.

Project Description:

This project identifies, quantifies and evaluates the incremental costs and benefits of demand responsive (DR) lighting controls system requirements in the California Energy Code across existing, non-residential building stock. The project focuses on the incremental costs and benefits associated with adding the DR functionality to enhance general lighting upgrades in existing, non-residential buildings to enable them to act as DR resources.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will advance intelligent, network controls to become dynamically controlled, dispatchable grid resources. The advanced controls developed will ease building participation in Auto-Demand Response (DR) programs and improve grid reliability and resiliency, improve user interfaces for lighting systems to reduce energy waste and cost, and enable IOUs and others to geographically target DR deployments as a cost effective means to transmission and distribution infrastructure upgrades.

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CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 5b

Lower Costs:

Demand response enabled, advanced lighting controls can significantly reduce customer energy consumption (50% - 70% in offices) and costs by optimizing light output when and where it is needed, and by minimizing its use when not needed through the deployment of highly granular networked sensors and efficient light sources.

Greater Reliability:

Increased customer participation in demand response programs especially for lighting resources, can increase grid reliability by five percent and reduce utilities' need for purchasing expensive electricity during periods of high demand.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $130,529
EPIC Funds Encumbered: $500,000	**EPIC Funds Spent:** $500,000
Match Partner and Funding Split: Energy Solutions: $138,648 (21.7 %)	**Match Funding:** $138,648
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 21 bidders	**Rank of Selected Applicant/ Bidder:** Group 4: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

APPENDIX B:
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Terms and Conditions.
Update: The project is complete. Research results indicate that networked lighting control systems will become an important distributed energy resource (DER) because it increases lighting system efficiency, flexible control and rapid-response capabilities, and eases load aggregation. As more facilities recognize the non-energy benefits of net worked lighting control systems, these systems are expected to see increased market adoption along with decreased prices. Additionally, as the electricity market becomes more volatile, these systems could help with grid balancing and stabilization. The final report will be published in January 2019.

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Project Name:

Customer-Centric Approach to Scaling IDSM Retrofits

[EPC-15-053]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

The California retrofit goal is to reduce 50% of existing buildings' energy use by 2030. Disadvantaged, low-income, multifamily communities are one of the most important retrofit targets, yet have no cost-effective pathways to achieve these goals. Multifamily housing is a very difficult market segment to address due to split incentives as retrofits are the responsibility of a property owner but he/she does not pay the energy bill. Limited technical and financial knowledge for owners also plays a role.

Project Description:

This project develops and demonstrates an approach to scale residential retrofits for disadvantaged communities that will focus on customer-centric solutions. This project develops and demonstrates an innovative approach, focusing on energy efficient retrofit packages that are non-intrusive to occupants and have the potential of reducing energy use by 30 to 40 percent.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project provides new data, analysis, and designs for cost-effective integrated demand side management retrofits such as advanced HVAC, smart thermostats, plug load controls, LED lighting, and heat pump water heaters for residential communities. These retrofits are designed to minimize tenant disruptions.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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Applicable Metrics: CPUC Metrics- 1f, 1h, 4a, 5b

Lower Costs:

These integrated retrofits could reduce energy use by 30 to 40% in multifamily buildings. The project could result in significant savings in energy and operating costs to building owners and residents.

Environmental Benefits:

This project has the potential to reduce greenhouse gas emissions due to the reduction in energy use by demonstrating a combination of energy efficient technologies and use of renewable energy in multi-family buildings.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $1,316,714
EPIC Funds Encumbered: $3,894,721	**EPIC Funds Spent:** $927,278
Match Partner and Funding Split: BIRA Energy: $25,000 (0.5 %) Southern California Edison: $312,572 (6.7 %) LINC Housing Corporation: $461,987 (9.8 %)	**Match Funding:** $799,559
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 39 out of 39 bidders	**Rank of Selected Applicant/ Bidder:** Group 5: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

For the Ontario site: The research team has completed installation of efficiency measures and has begun a 12-month monitoring and commission period. Technologies installed at Ontario include: HVAC heat pumps, attic insulation, upgraded windows, LED lighting, high efficiency appliances, smart thermostats, and fault detection diagnostic equipment. ">For the Fresno site installation is underway. Technology upgrades in Fresno include wall installation and dual pane window retrofits. In 2019, they plan to upgrade HVAC and water heaters.

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Project Name: Complete and Low Cost Retail Automated Transactive Energy System (RATES) [EPC-15-054]	
Recipient/Contractor: Universal Devices, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/30/2016 to 3/29/2019
Program Area and Strategic Objective: Applied Research and Development S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices	
Issue: Existing Demand Response programs, tariffs and wholesale markets in California are focused primarily on reliability and peak load reduction. The end-use loads enrolled in these programs tend to have high opportunity costs so participation in these programs is low. Participation logistics - including metering, telemetry, baseline estimation, verification and settlement - still serve as a barrier to wider participation. Substantial research and technology development over the past decade have pointed toward a vast untapped potential for balancing electricity supply and demand in near-real time through better management of customer loads and distributed energy assets.	
Project Description: This project will develop and pilot-test a standards-based Retail Automated Transactive Energy System (RATES), and behind the meter energy management solution. The purpose is to minimize the cost and complexity of customer participation in energy efficiency programs, maximize the potential of small loads to improve system load factor, shave peaks, integrate renewable generation, and provide low opportunity-cost resources to the grid. This project will work with Southern California Edison to facilitate customer participation and expand Demand Response Participation in the area served the Moorpark substation.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project is developing an energy management automation platform that will allow customers to participate in Demand Response (DR) markets by providing them the means to pre-program their preferred operational settings for end-use devices such as thermostats, pool pumps, and battery storage under variable pricing conditions. The technology is	

applying those preferences to automating real-time response to energy market and rate variations using off-the-shelf equipment and a two-way subscription tariff design that allows customers to consume when prices are low and conserve when prices are high, without the need for complicated measurement, verification, and baselines. This technology will reduce barriers to low cost, anytime responsiveness from millions of customers and their devices by solving the significant cost and complexity of current DR participation options.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1c, 1e, 1f, 1g, 1h, 3f, 4a

Lower Costs:

The primary goal of the project is to reduce the cost of customer participation in energy efficiency and automated demand response programs. Expanded participation will lower ratepayer costs by reducing procurement and grid capacity expansion costs as well as reducing carbon emissions and helping integrate renewables.

Greater Reliability:

Greater resiliency of demand will increase reliability as additional variable renewable generation resources are added to the grid. Variable renewables require procurement of additional "firming" resources to provide both ancillary services and generation resources when renewable production drops. Successful expansion of the ability of loads to respond to supply variation allows grid operators an additional tool to balance demand and supply.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $3,187,370	**EPIC Funds Spent:** $2,493,558
Match Partner and Funding Split: TeMix, Inc.: $919,325 (21.5 %) TBD Electrical Contractor: $7,000 (0.2 %) TBD - Controls: $1,150 (0.0 %) Universal Devices, Inc.: $160,235 (3.7 %)	**Match Funding:** $1,087,710
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	19 out of 21 bidders	Group 2: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is on schedule, required deliverables have been provided, and the level of engagement by utilities and other partners is expanding the project impacts beyond what was initially anticipated in the agreement. SCE has provided additional funding to support expansion of the research in the Moorpark substation area (a Disadvantaged Community also at risk for reliability issues). In addition, Google has been working with the team to evaluate its Alexa technology as a platform for hosting the transactive client. Demonstrations are underway and SCE has provided funding to expand the number of test sites and include battery storage in the pilot, as well as facilitating expanded participation in CAISO markets by developing and getting CPUC approval for an experimental tariff tailored to this project. The final report is anticipated January 10, 2019.

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Project Name:

The Charge Bliss Advanced Renewable Energy Community for a Disadvantaged Southern California Community

[EPC-15-055]

Recipient/Contractor:

Charge Bliss, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 3/30/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

Disadvantaged communities, especially those with low air quality, may seek to incorporate electric vehicles and photovoltaics (PV) to meet their clean energy goals. However, planning the locations and amounts of community scale PV, electric vehicle charging, and storage can be complicated and costly – and many disadvantaged communities do not have the resources to design the community. Cities need examples of how other disadvantaged communities planned, permitted, and designed community scale systems that incorporate energy storage, electric vehicle charging networks, and distributed generation in a way that minimizes the need for additional grid upgrades.

Project Description:

This project demonstrated how the City of Carson's disadvantaged downtown community could plan and design an advanced energy community that included an extensive electric vehicle charging network, high penetrations of photovoltaic (PV) generation, and stationary battery storage in their municipal parks and city-owned facilities. The project team used transportation and utility data to develop a plan for where to place EV charging stations within areas with high electric grid congestion and how the associated increased energy demand could be balanced with solar and storage to minimize grid impacts. The team conducted planning, permitting, financial modeling, and engineering design for over three megawatts of PVs and 40+ charging stations for a disadvantaged public sector and commercial area in the City of Carson. Charge Bliss collaborated with two local government entities, South Bay Cities Council of Governments, and Southern California Association of Governments, as well as a collection of universities and private companies on this effort.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

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SB 350 (2015) sets a 50 percent renewable energy standard by 2030 and a doubling of energy efficiency savings in buildings by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project piloted innovative planning, permitting financing, and engineering approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 3b, 3e

Lower Costs:

This project will reduce the time and costs needed to bring future community-scale IDER projects to a shovel-ready state.

Economic Development:

This project piloted new approaches that increase the financial attractiveness of community-scale IDER projects, which could lead to increased investment in the community.

Consumer Appeal:

Greater deployment of advanced energy technologies at a community scale will increase consumer familiarity and comfort with ZNE homes and communities, increasing the likelihood that consumers will choose to live in communities deploying advanced energy technologies.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $197,815
EPIC Funds Encumbered: $1,500,000	**EPIC Funds Spent:** $1,322,212
Match Partner and Funding Split: Efacec: $20,000 (1.3 %) Ji Min: $25,000 (1.6 %) Edward Kjaer: $8,325 (0.5 %) Tanner Engineering: $43,612 (2.7 %)	**Match Funding:** $96,937
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 28 bidders	Group 4: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team worked with community, technical, and civic stakeholders to develop a plan that selected the best public buildings and parks to install energy storage, an extensive electric vehicle charging network, photovoltaic, and smart control technology – keeping in mind impacts to the grid, ZNE status, and cost. After completing the engineering design documents, the complete package was submitted to Carson. However, as of the end of 2018 the city chose not to further peruse the proposed development. This project demonstrated that early and frequent engagement with the community and civic leadership is an important aspect for advanced energy community efforts to avoid delays and re-designs that may arise from issues such as the need to compensate for pre-existing community priorities a

APPENDIX B:
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Project Name: Peninsula Advanced Energy Community (PAEC) [EPC-15-056]	
Recipient/Contractor: Natural Capitalism Solutions, dba Clean Coalition	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/27/2016 to 6/30/2018
Program Area and Strategic Objective: Market Facilitation S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure	
Issue: Solar Emergency Microgrid (SEM) projects often struggle to establish a clear payback period, as payback periods are largely site-specific, requiring intensive analysis to determine which sites will provide the best value proposition. This analysis can drive up the soft costs associated with microgrid projects. SEM projects also struggle to demonstrate acceptable pay-back periods needed to secure project financing. This is partly due to putting a monetary value on resiliency benefits provided by the microgrid.	
Project Description: Clean Coalition planned and designed a Solar Emergency Microgrid (SEM) for the southern portion of San Mateo County. The team developed several case studies to guide SEM site selection based on which services would be included and their implicit or minimum loads, facility type, interconnection options, resources available, proximity of the site to local hazards, and available financing options. The project team used the case studies to inform their work with the local planning and building departments to streamline zoning and engineering permitting for optimal SEM sites. To help incentivize microgrid investments, including for the project's SEM, the project team worked to establish a backup power valuation methodology to use in commercial applications.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments are playing a critical role in achieving this goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and	

electric vehicles. This project is piloting innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.
CPUC Proceedings addressing issues related to this EPIC project: Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003
Applicable Metrics: CPUC Metrics- 2a, 3b, 3e Lower Costs: Streamlined planning and permitting, as well as new financial models will lower the time and capital costs associated with the AEC developments. This will make AECs more affordable for both developers and consumers. Economic Development: This project is piloting new approaches that increase the financial attractiveness of community-scale IDER projects, which could lead to increased investment in the community. Consumer Appeal: Greater deployment of AECs will increase consumer familiarity and comfort with Zero Net Energy homes and communities, increasing the likelihood of consumers choosing to live in an AEC. Energy Security: Microgrids using renewable energy generation, coupled with storage systems, allows consumers to generate their own energy locally.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $312,711
EPIC Funds Encumbered: $1,318,997	**EPIC Funds Spent:** $1,141,781
Match Partner and Funding Split: Natural Capitalism Solutions, dba Clean Coalition: $330,000 (20.0 %)	**Match Funding:** $330,000

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27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project concluded in June 2018 and Clean Coalition submitted a finalized master community design and case study, including four SEM models for different sites located in a disadvantaged community. These models integrate solar PV, energy storage, and electric vehicle charging infrastructure (EVCI), to increase resiliency from power outages. The project team is still pursuing a plan to connect all four sites, and is working with PG&E on the design. Additionally, several tools were developed to overcome economic, policy, and technical barriers that hinder AEC development, which include a streamlined permitting tool, a solar siting survey, and an EVCI master plan. The recipient has updated the project-specific page on their website: http://www.clean-coalition.org/our-work/peninsula-advanced-energy-community/.</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings

[EPC-15-057]

Recipient/Contractor:

The Regents of the University of California on behalf of the California Institute for Energy and Environment

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

The services demanded by commercial building customers--heating, cooling, ventilation, lighting, and so on--require significant energy and contribute to peak energy demand. Large commercial customers typically have a building management systems (BMS) that can be used to control HVAC and lighting in order to respond to price signals. However, small commercial customers typically do not have such capability, and thus cannot easily participate in demand response (DR). There are few DR solutions that address the complexity and heterogeneity for the diverse and varying needs of all commercial customers.

Project Description:

The purpose of this project is to improve small and large commercial customer participation in demand response programs by providing a cost-effective energy management system that allows a wide range of service offerings as well as effective and automated price-based management. The project will develop automated control systems capable of responding to dynamic pricing and program designs. Design improvements include: 1) receive price signals and evaluate energy demand; 2) enable heterogeneous customers to adapt to DR with individual preferences; 3) track, evaluate and control multiple devices; 4) interoperate with various building systems; 5) retain the electrical usage history of connected devices; 6) provide pricing based load management algorithms; 7) coordinate to maintain load diversity; 8) provide security; and 9) provide value by allowing customers to minimize the opportunity costs of participating by selecting the least-impactful load management strategy.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is developing an open source software solution that is combined with an open architecture enabling platform. The eXtensible Building Operating System (XBOS/DR) can

interface with multiple hardware devices from different vendors as well as include software applications from various vendors. With its ability to create a virtual building management system for small commercial buildings by networking thermostats and other controllers, XBOS/DR can provide large and small commercial customers with a variety of choices for DR capability. The open architecture can foster technical innovation by third-party vendors and other manufacturers in providing energy services.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1c, 1e, 1g, 1h, 4a

Lower Costs:

The recipient estimates that the XBOS software has the potential to reduce energy costs for ratepayers by $260 million per year in 2024 - due to lower demand charges, increased electric grid energy efficiency, reduced energy end-use from persistent efficiency in parallel with DR, and lower generation costs.

Greater Reliability:

The XBOS software has the potential to reduce or shift 450 MW of peak electric demand by 2024. This is a 150% increase beyond the current 293 MW of DR from a combination of nonevent-based programs, critical peak pricing, and peak-time rebates estimated by the California Energy Demand 2016-2026 Revised Forecast.

Environmental Benefits:

The project has the potential to reduce 930,000 metric tons of CO2e and 130 metric tons of NOx emissions per year avoided in 2024 from: increased electric grid energy efficiency, increased end-use energy efficiency in parallel with demand-management, and an increased fraction of intermittent operationally GHG-free renewable electricity generation.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $1,373,762
EPIC Funds Encumbered: $4,000,000	**EPIC Funds Spent:** $1,126,095
Match Partner and Funding Split: Siemens Corporation, Corporate Technology: $400,000 (9.0 %) Quantum Energy Services & Technologies, Inc. (DBA: QuEST): $24,000 (0.5 %)	**Match Funding:** $424,000

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N/A</td><td colspan="2">Leveraged Funds:
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<tr><td>Funding Method:
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Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 21 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

There are several open source IP being used, including: the eXtensible Building Operating System, the Monitoring and Actuation Profile, the Building Operating System Services Wide Area Verified Exchange, the Berkeley Tree Database, Giles, and OpenBAS.

Other IP include: Semantic Integration of Wearable Sensors into Professional Healthcare, EnergyOP, and OWL implementation of SPC201.</td></tr>
<tr><td colspan="4">Update:
The project team successfully demonstrated the transactive signal server in a dispatch demonstration as well as preparing the Packaging, Configuration, and Distribution Scripts Report, which describes how to download and configure the XBOS software. All installations in the small commercial buildings were completed. Training has begun for facilities managers on the new interface, and feedback will be sought from the managers to determine response priorities and strategies. The project team will finish developing baseline strategies for all buildings as a basis for evaluating the DR strategies and energy efficiency measures being tested. The field testing report is due June 2019. The project was extended six months in order to leverage DOE funding to pursue using the XBOS platform to control loads based on micro-synchrophasor data. The Final Report is expected in July 2019.</td></tr>
</table>

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Project Name:

The Oakland EcoBlock - A Zero Net Energy, Low Water Use Retrofit Neighborhood Demonstration Project

[EPC-15-058]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/27/2016 to 3/23/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

In order for California to meet its ambitious energy goals, cost-effective retrofit strategies must be found for the state's existing housing stock. Advanced Energy Community (AEC) developments that deploy a wide mix of clean energy technologies on a medium-to-large scale offer a way to retrofit entire communities, rather than on a building-by-building scale. However, community-scale energy retrofits are untested and models for governing and financing the energy systems are not established. Additionally, local governments, developers, and other stakeholders do not have standards for planning, permitting, and funding these types of developments, making their realization difficult.

Project Description:

This project developed a model for a residential block-scale retrofit development of an integrated energy system combining energy efficiency, renewable generation, and water conservation technologies, called the EcoBlock. The development of the energy and water system components of the model served as a case study to analyze different owner-operator, and financing structures that may be applicable to a residential community. This case study can help transform the EcoBlock model from a one-off demonstration to a sustainable and replicable model for the entire state. The City of Oakland will also use the EcoBlock model to develop new planning and permitting processes that can lower the time and cost of similar block-scale developments throughout the city.

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How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

SB 350 (De Leon, 2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Deploying customer-side of the meter technologies at scale will help meet this goal, but will require new innovations to how local jurisdictions design, plan, finance, and manage energy upgrades at the community level. This project is developing sustainable financing structures, clear owner-operator responsibilities, and streamlined planning and permitting processes, which are critical to successfully deploying community-scale energy retrofits throughout the state.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003 Water-Energy Nexus: R.13-12-011 [Closed] Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

Streamlined planning and permitting, as well as new financial models will lower the time and capital costs associated with AEC developments. This will make AECs more affordable for both developers and consumers.

Economic Development:

Increased AEC deployments can lead to increased demand in clean energy technologies and services resulting in broad economic benefits to the clean energy sector.

Consumer Appeal:

Greater deployment of AECs will increase consumer familiarity and comfort with ZNE homes and communities, increasing the likelihood of consumers choosing to live in an AEC.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $117,432
EPIC Funds Encumbered: $1,500,000	**EPIC Funds Spent:** $723,393
Match Partner and Funding Split: Rexel Foundation: $140,000 (6.2 %) Morgan, Lewis & Bockius LLP: $412,300 (18.2 %)	**Match Funding:** $769,846

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Perkins Coie: $41,250 (1.8 %)
The Regents of the University of California on behalf of the Berkeley campus: $26,296 (1.2 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-058 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project team completed a Community-Scale Zero Net Energy Retrofit Master Plan that includes 27 houses and 2 multi-family buildings in Oakland. The plan features a DC solar, storage, EV microgrid; energy efficiency retrofits; hybrid AC/DC homes; and a house-scale water efficiency systems. The planned systems are estimated to reduce block-wide CO2 emissions by about 65 percent, with near zero net energy reduction at the house scale. The project also identified Community Facilities Districts (CFD) as a viable mechanism for residents to collectively finance communal energy and water installations—both upfront capital and ongoing O&M costs—via assessments on property tax bills. The City of Oakland is using the results of this project to examine any needed changes to its planning or permitting policies to accommodate block-scale DER developments such as the EcoBlock.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

UniGen Smart System for Renewable Integration

[EPC-15-059]

Recipient/Contractor:

Onset, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/24/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

The electric grid was designed on the presumption of a predictable and slow-moving load and the generation scheduled to serve it. Grid managers rely on an Energy Management System to identify deviations from the scheduled generation. After a deviation, operators make adjustments manually and wait for the adjustment to take effect (approximately 10 to 30 minutes). During this time, disruption caused by the volatility of wind and solar most likely changes the operations of the grid. This variability results in increased threats to electricity reliability and costs to California ratepayers and may limit the amount of renewable electricity generation that can be accepted by grid operations.

Project Description:

This project is developing the UniGen Smart Software System to smooth energy output from a combination of variable energy resources (VER). VER generation often deviates from forecasts and schedules because of variations in weather. This can be alleviated by a fast-acting control system that automatically compensates for deviations from projected generation using a dedicated mix of energy resources (e.g., a photovoltaic system and an energy storage system). Onset's UniGen control system would couple these resources with a primary power plant using proprietary algorithms in a software application in real time so that the combined output corresponds to the committed output. Any deviation is solved at the project or distributed level, making it easier for the California Independent System Operator (CAISO) to manage grid performance.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is developing a software control system that would be a critical tool that can help integrate large amounts of VERs envisioned by California's energy policy (i.e., 33 percent by 2020 and 60 percent by 2030) along with current generation to create a more stable system. This software control system can simplify the CAISO's energy balancing efforts.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1a, 1h, 2a, 3a, 5a

Lower Costs:

The cost of using UniGen to couple a VER with a dedicated power plant can be substantial, up to $1M to $2M for every 100 MW of VERs. Preliminary results indicate that when using UniGen, market participants have financial incentives to schedule VERs, thereby enhancing the integration of a larger amount of renewables. The UniGen Smart System has the potential to save California ratepayers an estimated $25M a year by enabling VER to generate more energy (avoiding curtailment) and reducing the cost of maintaining the Day-Ahead Schedule.

Greater Reliability:

The software could help the California ISO maintain grid reliability and avoid non-compliance with NERC standards. If the controllable generation is insufficient or not timely during the afternoon peak, there is the threat that system frequency will fall below levels required by NERC. This system could assist the California ISO in real-time balancing, which should reduce the likelihood of over or under supply.

Environmental Benefits:

The software could help California achieve aggressive climate change goals by accelerating the penetration of higher levels of renewable energy sources.

Assignment to Value Chain: Grid Operations/Market Design		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $638,993		**EPIC Funds Spent:** $521,091	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 23 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Draft final report is late, but CAM working to obtain and review. New CAM just assigned after previous CAM retired.

Project Name: Optimizing Solar Facility Configuration Effects on Habitat, Managed Plants, and Essential Species Interactions [EPC-15-060]	
Recipient/Contractor: Regents of the University of California, Davis	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 7/21/2016 to 9/30/2019
Program Area and Strategic Objective: Applied Research and Development S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts	
Issue: Habitat variation and changes to species interactions within and adjacent to energy installations may regulate impacts to species of concern, including rare and invasive species. Typical management planning for both rare and invasive species takes a single-species approach, and may overlook how species' responses change over the variation in micro-environmental conditions within energy facilities and mitigation areas. In addition, altered species-interactions may drive long-term failure or success of species in landscapes modified by renewable energy development and operation.	

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Project Description:

">This research quantifies how microhabitat conditions that affect rare plants, invasive plants, and sensitive insects vary across a gradient of solar energy configuration, including sites within a solar field, mitigation areas within a solar field, sites on the margin of a solar field, and similar undisturbed locations. Researchers are determining how habitat variation affects target plant species and their essential species interactions, including herbivory, predation, and pathogens.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will provide methods to decrease adverse environmental impacts of solar energy facilities and enhance the ability to predict and overcome costly invasions of non-native plants in early stages. This research will also advance the effectiveness of mitigation measures, reduce impacts, and overcome barriers to facility siting and design by studying species responses in different conditions within a solar array and the changes in species interactions.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 4f

Lower Costs:

This research will reduce costs in the siting and deployment of renewable energy by assessing the benefits or ecological costs of different facility configurations, providing guidance for the design of future solar facilities and the cost-effective management of native and invasive species in existing facilities.

Environmental Benefits:

This research will benefit ratepayers by providing effective, efficient strategies for the management of state and federally listed species within and adjacent to energy facilities. The study will also inform facility managers about controlling invasive species in solar energy facilities.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$104,801
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$597,865	$331,684

APPENDIX B:
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<table>
<tr><td colspan="2">Match Partner and Funding Split:
The Regents of the University of California, Santa Cruz: $54,940 (7.8 %)
Regents of the University of California (University of California, Davis): $48,357 (6.9 %)</td><td colspan="2">Match Funding:
$103,297</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
45 out of 45 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 6: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project team set up the field experimental sites. They completed the data collection and analysis on microhabitat factors and are completing the experimental analyses. The photovoltaic-annual plant experiment is studying the effects of solar panels on temperature, moisture, and photosynthetically active radiation in their microhabitat and how those changes affect the growth, survival, and reproductive success of native and invasive species. Similarly, the concentrating solar-milkweed experiment is studying how changes in soil microhabitat caused by heliostats are affecting the success of a rare milkweed and its dependent butterflies, and the interactions with avian predators. The team held a technical advisory committee meeting in 2017; and a second meeting is in the planning stages.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Using Data-Driven Approaches to Design Advanced Energy Communities for Existing Buildings

[EPC-15-061]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/13/2016 to 3/30/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

Upgrading existing buildings in support of state climate goals is a monumental challenge. The limitations are greatest in disadvantaged communities (DACs) because of insufficient community involvement, a high percentage of renters, a lack of energy data supporting energy retrofit programs, and a lack of knowledge transfer due to education and/or language barriers. These limitations make it difficult for energy developers to acquire adequate participation from community residents at the scale needed to tackle this challenge. Furthermore, inadequate financing strategies to overcome capital costs of community-scale energy projects are amplified in DACs where financial risks are more impactful.

Project Description:

This project funded the planning, permitting, and preliminary engineering needed for the integration of advanced energy technologies in a disadvantaged community. The final design provides locally generated, GHG-free electricity from community solar and storage to offset electricity consumption of participants who opt in to the program. The design also enables participants to benefit from savings resulting from various onsite retrofits that enable better energy efficiency, energy management, and demand response. Participants will pay back retrofit costs and cost of capital for solar and storage assets through an on-bill financing mechanism, including a first-of-its-kind virtual net metering tariff across multiple county-owned sites and residential buildings piloted by Los Angeles Community Choice Energy. The project team developed robust data evaluation methods using the LA County Energy Atlas to efficiently and effectively identify high-need customers and site locations and to optimize project design and financing features. More information can be found at the project website: https://www.advancedenergycommunity.org/

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Local governments can play a critical role in achieving the state's SB 350 (2015) building energy efficiency goals by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) for energy efficiency. This project is piloting innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

This project will reduce the time, costs, and resources needed to bring community-scale integrated distributed energy resource (IDER) projects to a shovel-ready state.

Economic Development:

Increased demand for AEC deployments can result in broad economic benefits to the clean energy sector. This project is also serving to build community capacity around energy issues, which could increase support for local clean energy and economic initiatives.

Consumer Appeal:

This project is increasing consumer familiarity with ZNE homes and communities, which should increase support from the local community for greater deployment of advanced energy technologies at a community scale.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $449,666
EPIC Funds Encumbered: $1,497,996	**EPIC Funds Spent:** $851,246
Match Partner and Funding Split: Regents of the University of California, Los Angeles: $118,014 (6.3 %) Los Angeles County Office of Sustainability: $263,060 (14.0 %)	**Match Funding:** $381,074

APPENDIX B:
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<table>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project concluded in March 2018. The project has resulted in a shovel-ready AEC design in preparation for Phase II and has made several findings towards lowering barriers to access to energy efficiency and solar in local DACs. The implementation of a VNEM tariff was critical in showing financial viability of the design since it allows community members to share the benefits of local renewable power even if they cannot or prefer not to install solar panels and/or an energy storage system on their own property. The project team found that the existence of a Community Choice Aggregator (CCA) allows for streamlined deployment of a VNEM tariff, which may not be the case in areas without a CCA.</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Robust, Low-Cost, Real-Time, NOx Sensor for Optimization of Dispatchable Distributed Generation Systems

[EPC-15-062]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Irvine campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/7/2016 to 4/18/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Low emission distributed generation technologies, such as microturbines and reciprocating engines, can improve onsite resiliency and reduce peak demand. However, assuring that these systems produce minimal emissions is paramount. As a result, there is a need for a low cost approach to monitor emissions performance.

Project Description:

The project tests several recently developed sensors with the capability to detect low NOx levels generated by dispatchable generation systems, such as internal combustion engines and/or microturbines. Deploying clean, efficient, distributed generation systems directly addresses goals stated in AB 32, SB 350, and the Clean Energy Jobs Plan. While reducing greenhouse gases and improving efficiency are vital, maintaining strict air emission standards is also important. DG systems often suffer performance degradation over time once deployed. This may lead to increased emissions of air pollutants, such as NOx. The proposed solution offers a cost effective means to monitor the real time emissions of the system and information that can be used to optimize system performance and maintain low emissions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The NOx sensor is based on ceramic solid-state electrochemical sensor technology, similar to an automotive oxygen sensor. Solid state NOx sensors have been developed for direct in-situ measurement of exhaust to meet stringent on-board diagnostic requirements for self-diagnosis and reporting, including required sensitivities down to parts-per-million. The NOx sensor combines existing commercial NOx sensors with newly developed electronics for use in applications, including dispatchable distributed generation like microturbines. Unlike other

NOx sensors, the sensor is a simple solid state device, with a single cell and no internal diffusion chambers (electrodes directly in the flow). This gives it faster responsiveness, and makes it both more robust and easier to manufacture.

CPUC Proceedings addressing issues related to this EPIC project:

Combined heat and power: D.10-12-035., R.08-06-024. [Closed]

Applicable Metrics: CPUC Metrics- 2a, 3f, 4b

Lower Costs:

The cost with adding the sensor system to a given engine is estimated to be about $2,000. This number should come down with a higher number of units. Because the solid-state sensor technology and control algorithm approach optimizes the engine parameters to reduce emissions and does not alter the performance or configuration of the device in a significant way, it represents a feasible and viable approach to improving the emissions performance of DG systems in California.

Environmental Benefits:

For the estimated current 50 MW fleet of microturbine generators (MTGs) in California, a 10% reduction for each device at part load will reduce NOx emission by 30 tons each year. The estimated 50 MW fleet of MTGs is very small compared to the fleet of reciprocating engines; it would be worthwhile to consider a similar evaluation of benefits as applied to these systems.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $53,531	
EPIC Funds Encumbered: $200,000		**EPIC Funds Spent:** $167,135	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 11: Ranked # 8

APPENDIX B:
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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research team has completed the technical work and submitted the draft final report. The results show that the two automotive solid state NOx sensors selected proved durable enough to perform reliably for the 6-month evaluation. The research team developed an engine control system integrated with information from the solid state NOx sensor and successfully demonstrated the ability to actively reduce NOx emissions at part load by 10%. The results show that solid state sensors represent an inexpensive and viable approach for monitoring emissions from distributed generation systems.

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Project Name:

Innovative Net Zero: ZNE Demonstration in Existing Low-Income Mixed-Use Housing

[EPC-15-064]

Recipient/Contractor:

Prospect Silicon Valley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 9/19/2018

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

The State of California has set ambitious net-zero energy targets, including that 50 percent of existing commercial buildings achieve net-zero by 2030. This aggressive target is especially challenging for buildings under 50,000 square feet. Challenges include significant capital costs (labor and equipment); building conditions (conflicting infrastructure energy effects, aging physical conditions which do not easily accommodate state-of-the-art technology); operational considerations (occupant behavior, transaction timing and lack of maintenance expertise); and legal and policy factors (split incentives).

Project Description:

This project was to demonstrate the installation of innovative energy efficiency technologies in a retrofit of an existing, low-income, mixed-use multi-unit building in a dense urban setting to become zero net energy (ZNE). The recipient was unable to identify cost effective retrofits that met the requirements of the grant. As a result, the agreement was mutually terminated.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project site represented a test case for many of the complex challenges facing zero net energy retrofits of multi-unit, mixed-use buildings. If successful, the project approach could have been packaged for broad dissemination to the design community.

CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 4a
Lower Costs:
The implementation of energy efficiency measures can lower electricity costs for building owners. If the project was successful, it had the potential of reducing building energy use by 40 percent for both electricity and natural gas.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$408,130</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,995,653</td><td colspan="2">EPIC Funds Spent:
$374,309</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Chinatown Community Development Center: $800,000 (21.1 %)</td><td colspan="2">Match Funding:
$800,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 5: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
On July 13, 2017, PSV informed Energy Commission staff that the project would require an unanticipated $1 million electrical upgrade in order to install the selected retrofit measures and the PV system. PSV attempted to identify alternative financing to fund the electrical service upgrade and identify new measures that could be installed using the existing electrical service. It also explored options for doing the project at a different site. However, it was unable to identify a suite of acceptable retrofit measures and a site that met the solicitation requirements and could be completed within the term of the agreement. PSV</td></tr>
</table>

agreed to a mutual termination of the project. The termination was approved at the September 21, 2018 Business Meeting.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Berkeley Energy Assurance Transformation (BEAT) Project

[EPC-15-065]

Recipient/Contractor:

City of Berkeley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/31/2016 to 6/30/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

Cities are at the forefront of the sustainability and resilience movement, and are looking for multi-benefit solutions that enhance the safety and environmental quality of their communities. Multi-facility microgrids can help communities reduce their carbon footprint by offering clean, localized generation and increased resiliency during power outages. However, they are still at an early stage of development, and most existing projects are located on private campuses, or are located in remote settings at the end of a utility distribution line.

Project Description:

The BEAT project focused on designing a clean energy microgrid for the public good that could be integrated into the existing fabric of a dense urban city. The project analyzed the feasibility of designing a multi-building, urban microgrid that uses solar and energy storage to share power between existing buildings to better regulate day-to-day energy supply. Additionally, in the case of a power outage, the microgrid would be able to "island" itself from the grid and provide clean back-up power for critical buildings. The BEAT team conducted a series of coordinated regulatory, technical and financial analyses to determine site feasibility, optimal configurations, operation criteria, financing strategies, and lessons learned.

The financing and regulatory models provide pathways and recommendations for dense urban communities looking to develop microgrids that cross the public right-of-way. Using this analysis, other microgrid projects will be able to evaluate the benefits and challenges of urban microgrids and accelerate the non-technical planning, modeling, and financing options for microgrid and/or solar + storage projects.

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How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Senate Bill 350 (2015) set a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments are playing a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project is piloting innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

Streamlined planning and permitting, as well as new financial models will lower the time and capital costs associated with Advanced Energy Community (AEC) developments. This will make Advanced Energy Communities more affordable for both developers and consumers.

Greater Reliability:

The project will increase energy reliability by enabling districts in downtown Berkeley to localize power generation and distribution.

Economic Development:

Increased AEC deployments can lead to increased demand in clean energy technologies and services resulting in broad economic benefits to the clean energy sector.

Energy Security:

Microgrids using renewable energy generation, coupled with storage systems, allows consumers to generate their own energy locally.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$500,070
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,499,214	$1,269,149

APPENDIX B:
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<table>
<tr><td colspan="2">Match Partner and Funding Split:
Office of Energy and Sustainable Development, City of Berkeley: $106,475 (6.1 %)
Bay Area Regional Energy Network: $54,000 (3.1 %)
Center for Sustainable Energy: $11,200 (0.6 %)
NHA Advisors: $7,500 (0.4 %)
URS Corporation: $60,946 (3.5 %)
West Coast Code Consultants Inc.: $10,000 (0.6 %)</td><td colspan="2">Match Funding:
$250,121</td></tr>
<tr><td colspan="2">Leverage Contributors:
City of Berkeley: $248,009</td><td colspan="2">Leveraged Funds:
$248,009</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project concluded in June 2018. The recipient aimed to create a shovel-ready design for an islandable, clean energy microgrid community by integrating buildings located throughout downtown Berkeley. However, challenges with crossing the public right-of-way on existing distribution lines between these non-adjacent buildings, as well as the high-cost for new distribution lines and a lack of incentives through PG&E's current tariff structure made the original design cost-prohibitive. The project team changed directions and opted to create designs for separate solar + storage systems, coupled with energy efficiency measures and smart building operation at three locations. The design allows the city to meet its resiliency goals, reduce utility energy consumption by 36-43 percent, and reduce its existing reliance on backup diesel generators during power outages, by up to 40 percent.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Developing an Advanced Energy Master Plan for the Encanto Neighborhood in San Diego

[EPC-15-066]

Recipient/Contractor:

Groundwork San Diego-Chollas Creek

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	7/26/2016 to 3/30/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

Many of the state's low income residents live in older, urban, built-out disadvantaged communities characterized by a range of challenges including: an aged housing stock, densely built residential areas, under-developed commercial areas, depressed socio-economic conditions, and limited public and private investment. These physical and social conditions present a number of barriers for deploying emerging clean energy technology solutions into the community. For example, many of the older homes cannot physically support solar PV panels or other energy upgrades.

Project Description:

This project developed a prototype plan, called the Encanto Social-Economic Education Development (EnSEED) that attempts to overcome the social, financial and physical barriers to deploying emerging clean energy technology solutions in disadvantaged communities. As part of this project, the project team piloted several digital and in-person outreach strategies to the community, designed to transform an existing disadvantaged community in Southeastern San Diego into a community of near-zero net energy (ZNE) buildings. This project sought close engagement with the local community, and developed a final system design of a community-scale DER deployment as well as an accompanying financing plan. The project also developed a permitting plan that documented the necessary permit processes and required government review and approvals for deploying community-scale DER developments.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving the goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community scale.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

Streamlined planning and permitting, as well as new financial models will lower the time and capital costs associated with AEC developments. This will make AECs more affordable for both developers and consumers.

Economic Development:

This project evaluated approaches to increase the financial attractiveness of community-scale IDER projects, which could lead to increased investment in the community.

Consumer Appeal:

Greater deployment of AECs will increase consumer familiarity and comfort with ZNE homes and communities, increasing the likelihood of consumers choosing to live in an AEC.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $129,898
EPIC Funds Encumbered: $1,500,000	**EPIC Funds Spent:** $1,421,437
Match Partner and Funding Split: Blue Flame Energy Finance: $520,000 (25.7 %)	**Match Funding:** $520,000

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-066 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project completed in 2018. As part of the project, the project team conducted a case study to document the various challenges and lessons learned in pursuing a community-scale clean energy system in a disadvantaged community. One of the challenges encountered during the project was that it took nearly eight months to receive community energy-usage data, which prevented the project team from being able to model the system design. As a result, the case study recommended that future teams submit their data requests early in the process. The case study also found that public schools could potentially serve as the location of onsite solar generation for the community since most residences may not have the ability to support rooftop PV.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Integrated Community Resource Marketplace

[EPC-15-067]

Recipient/Contractor:

The Local Government Commission

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 3/30/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

Local governments often have ambitious climate and energy goals but lack integrated approaches to help them identify, select, and implement high-quality, cost-effective projects to meet those goals and contribute to community prosperity. At the local level there is no structured process to combine, leverage and layer funding mechanisms with project opportunities to 1) realize deeper resource savings, 2) identify more impactful projects, or 3) reach critical scale to engage private investment.

Project Description:

This project developed a platform, called the Integrated Community Resource Market (ICRM), that utilizes the City of Fresno's existing policy and development plans, stakeholder input, and additional research, to compile a comprehensive list of development projects that are financially viable, align with current policy goals and timelines, and, upon implementation, produce verifiable savings of energy, greenhouse gas, and water. With a portfolio of projects identified, the project team used the platform to analyze each project to identify options for funding and financing the project, and carried out a financial analysis of each project to examine energy cost savings, incremental measure cost, return-on-investment in the form of payback with and without funding incentives, and property value improvement. This analysis was combined to develop a Master Community Design, which describes a suite of projects and specific processes for Fresno to consider adopting. Additional information is available at the project website: https://www.lgc.org/energize-fresno/

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

SB 350 (2015) sets a 50 percent renewable energy standard by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and energy storage. This project piloted innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 3b, 3e

Lower Costs:

This project will reduce the time and costs needed to bring future community-scale IDER projects to a shovel-ready state.

Economic Development:

This project piloted new approaches that increase the financial attractiveness of community-scale IDER projects, which could lead to increased investment in the community.

Consumer Appeal:

Greater deployment of AECs will increase consumer familiarity and comfort with ZNE homes and communities, increasing the likelihood of consumers choosing to live in an AEC.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $432,890
EPIC Funds Encumbered: $1,500,000	**EPIC Funds Spent:** $1,298,452
Match Partner and Funding Split: Local Government Commission: $12,445 (0.8 %)	**Match Funding:** $12,445
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 28 bidders	Group 3: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project concluded in March 2018. The project team developed and implemented the ICRM platform on Fresno's Blackstone Avenue Corridor. The platform identified a portfolio of projects and programs that contribute to grid reliability and resiliency, increase energy efficiency and renewable energy, and deploy smart grid and zero net energy technologies. In all, 13 development sites, two activity centers, two program enhancements, and two electric vehicle charging proposals were identified as having the highest potential to provide benefits to Fresno. This portfolio is estimated to cost $30.8 million in capital expenditure and save participants $4.6 million annually net of financing costs, and generate approximately $1 million annually in positive cash flow. The final project report is available at https://www.energy.ca.gov/2018publications/CEC-500-2018-02

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Understanding and Mitigating Barriers to Wind Energy Expansion in California

[EPC-15-068]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	7/21/2016 to 3/30/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

The need to transition from traditional hydrocarbon-based sources of energy becomes ever more compelling as energy demand rises in tandem with the necessity to reduce greenhouse gas emissions. Wind energy already plays a key role in diversifying and greening many energy portfolios. However, wind speeds vary across space and time, which affects where wind farms should be sited, as well as their reliability. Accurate projections of wind energy potential and investment in the industry depend on the stability and predictability of wind resources and the operating environment, which are not well understood in a changing climate.

Project Description:

The research used a combination of global re-analysis datasets, a unique set of observations, and high-resolution global climate model simulations to help identify and characterize the extent to which regions in California may exhibit vulnerability or new opportunity in terms of changes to wind resource magnitude, spatial and temporal variability, and/or operating conditions of sufficient magnitude to alter their viability for wind energy development. The unique strength of this research lies in the use of a next generation variable resolution global climate model that has the ability to simulate climate change over a limited area region, i.e., California, in a computationally cost effective manner.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will help overcome a key barrier to long-term wind energy investment that can help California meet its renewable energy and climate change mitigation goals. Improving the understanding of wind resource magnitude and variability over many time scales and in the context of climate change can improve the precision with which wind resources can be forecast. Technological advancement was realized through use of a next-generation variable-

resolution coupled atmosphere-ocean global climate model that is capable of simulating climate and climate change at relatively high spatial resolution (7km to 14km) over California. This was the first time that a variable-resolution climate modeling system has been used for a specific energy application.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Strategies and Guidance for Climate Change Adaptation: R.18-04-019 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 5c

Lower Costs:

As the science and understanding of wind resource variability over many time scales are improved, the precision with which wind resources can be forecast will improve, which will lower the risk, and associated costs, of developing wind power. This cost reduction will benefit electricity consumers and developers. Furthermore, these lower costs could allow wind power to serve a greater portion of power generation needs within the state.

Greater Reliability:

The project will improve the characterization of uncertainty around the magnitude and variability in space and time of California's wind resource in the near and mid-term. Grid operators could use more accurate projections of potential changes to the wind resource to more efficiently use it.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $74,830	
EPIC Funds Encumbered: $200,000		**EPIC Funds Spent:** $200,000	
Match Partner and Funding Split: UC Davis: $54,000 (20.0 %) DNV GL: $16,000 (5.9 %)		**Match Funding:** $70,000	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 11: Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project was completed in 2018. The final report is online at https://www.energy.ca.gov/2018publications/CEC-500-2018-035/CEC-500-2018-035.pdf. The study discovered that observable large-scale patterns such as El Nino can help improve near-term predictions of wind generation. Based on future wind projections from one climate model, the team predicts that with climate change, wind power would increase during summer in most of the state and decrease during fall and winter. This study improves the characterization of uncertainty around the magnitude and variability in space and time of California's wind resources in the near future, which can reduce risk to investors and lead to greater investment in wind energy. The team communicated through three journal articles in 2018, wind investors on TAC, and an industry consultant as a project partner.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Lancaster Advanced Energy Community (AEC) Project

[EPC-15-069]

Recipient/Contractor:

Zero Net Energy Alliance, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	7/13/2016 to 3/30/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

In 2011, the city of Lancaster set a goal to become the first Zero Net Energy (ZNE) City. Regulatory and pricing issues, including high up-front costs, burdensome interconnection applications, and unproven business models continue to be significant barriers to deployment of advanced energy technologies at the scale Lancaster needs to achieve its goal. This project seeks to address (1) how to enable ZNE residential communities from both a financial and technical perspective, and (2) how to capture the value of DERs in a standardized manner to develop viable business models and attract the financial investment needed to support widespread deployment of clean energy resources.

Project Description:

In collaboration with the City of Lancaster and Lancaster Choice Energy (LCE), this project planned a ZNE microgrid connected to an affordable housing project that enables the cost-effective deployment of advanced technologies. The microgrid design minimizes the impact of increasing renewables on the grid, increases DER design flexibility, enables local control of energy management, and exploits the plummeting cost of islanding capability to provide valuable resiliency benefits to the community. The project team also developed a community DER valuation framework that assesses the value of DERs on an aggregated and integrated network basis from multiple stakeholder perspectives by combining various value streams and evaluating evolving revenue and market participation opportunities. This framework was used to inform the shared services model behind a "Green District" program that integrates storage, solar, and smart building technology as a service for large commercial and industrial customers to reduce their demand charges while allowing LCE to save on procurement costs. More information can be found at the project website: http://www.znealliance.org/projects/lancaster/

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Local governments can play a role in achieving California demand reduction goals by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community scale.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

This project is outlining how ZNE residential subdivisions can use municipal bonds to finance DER infrastructure with lower interest rates than commercially available third party financing. The project is also working on streamlining the interconnection process for new ZNE communities, which will reduce costs and resources needed to establish a ZNE community.

Greater Reliability:

The tools and resources developed under this project will assist in identifying citywide optimal microgrid sites that will have the most local generation potential and minimize impacts on grid reliability.

Economic Development:

By providing tools to overcome some obstacles to DER deployment and DER programs, this project could spur the development of these sectors in other communities. When deployed properly, DERs can provide energy savings, and their installation and maintenance creates a variety of jobs. This development also leads to new investment in the community.

Consumer Appeal:

This project will increase consumer familiarity with ZNE homes and communities, which should increase support from the local community for greater deployment of advanced energy technologies at a community scale. The project is also developing an innovative stationary storage program that minimizes up-front capital costs through innovative ownership and value sharing models.

Energy Security:

Microgrids using renewable energy generation, coupled with storage systems, allows consumers to generate and manage their own energy locally.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$507,982</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,469,779</td><td colspan="2">EPIC Funds Spent:
$1,215,620</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
City of Lancaster: $1,500,000 (50.5 %)</td><td colspan="2">Match Funding:
$1,500,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project concluded in March 2018. The project has resulted in a shovel-ready advanced energy community design in preparation for Phase II that includes a microgrid connecting a zero-net-energy community of 75 single-family homes for low-income residents. The project team also developed a number of resources for local governments to overcome barriers to building ZNE communities and widespread deployment of distributed energy resources. For example, they developed a financial model and policy framework for municipalities to consider land-secured financing as an option for building new residential ZNE communities. They also developed a DER valuation framework to help municipalities identify and analyze the potential value streams from community-scale deployments of solar PV, electric vehicles, battery storage, and demand response programs.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System

[EPC-15-070]

Recipient/Contractor:

Altostratus, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/7/2016 to 5/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Probabilistic seasonal and decadal climate forecasts for the electricity system are typically done at coarse-resolution regional scales and do not incorporate impacts from urban areas in models. Intra-urban variations in temperature are on average between 1 and 4 degrees C in most urban areas in California and can be as large as 10 degrees C. It is important to explicitly account for them in the seasonal, decadal, and short-term forecasts of the electric system that serve as a basis for planning by the Energy Commission and the utilities.

Project Description:

This project develops and applies methodology to improve the representation of urban effects in probabilistic and short term forecasts for the electricity system. It quantifies intra-urban climate variability in California for inclusion into electricity demand forecasts used by the Energy Commission and the utilities. The characterizations are based on state-of-science highly-urbanized atmospheric modeling supplemented by analysis of observational weather data. The researcher detailed statistical correlations and analysis focusing on summertime conditions, and developed transfer functions to facilitate use of results by the Energy Commission and utilities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will add fine-resolution, intra-urban climate detail to coarse-scale, regional-level probabilistic or deterministic forecasting, thus allowing for more accurate, area-specific characterizations and forecasts for the electricity system and better apportionment of electricity generation.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e
Greater Reliability:
This project is expected to improve electric system reliability by reducing uncertainty in seasonal and decadal probabilistic weather forecasts as well as short-term forecasts used by the Energy Commission and utilities for management of the electric system. This project reduced mean urban temperature forecasting error by up to 1.8°C in the San Francisco Bay Area and up to 0.8°C in the Los Angeles region. Conservatively assuming an average improvement of 0.5°C in forecasting peak temperatures in Californian cities within the CAISO service territory, the improved accuracy translates into savings of ~ ½ GW in generating capacity, which is equivalent to output from 1 to 3 large power plants.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$14,035</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$193,326</td><td colspan="2">EPIC Funds Spent:
$173,767</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Altostratus, Inc.: $5,000 (2.5 %)</td><td colspan="2">Match Funding:
$5,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
45 out of 45 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 11: Ranked # 6</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The researcher has gathered and analyzed hourly weather data from each monitoring area (Greater San Francisco Bay Area, Fresno-Bakersfield, and Los Angeles regions). The researcher also configured the Weather Research and Forecasting (WRF) atmospheric model, so the fine-resolution simulation results generated by the model can be compared with the observational data. Most recently, the researcher developed the correlations and functions to characterize and quantify intra-urban climate variability in probabilistic, short-term weather forecasts for the electric system.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Zero Net Energy Farms

[EPC-15-071]

Recipient/Contractor:

Biodico, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/1/2016 to 3/31/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

Farms depend on the electricity grid and fossil fuels for everyday operations. These demands continue to increase and expand as new farming technologies are introduced and as ground water pumping demands increase. Many farms lack the tools and knowledge necessary to deploy distributed renewable technologies to meet these demands in place of conventional energy systems or increased reliance on the electricity grid. Furthermore, farms need guidance to effectively address permitting requirements and find competitive funding alternatives that will allow them to become leaders in California's distributed and renewable energy future.

Project Description:

This project developed and piloted a Project Management Application tool for farm and agricultural communities. Included in this tool is information gathered from a trade study of available equipment vendors that will compare cost effectiveness and reliability of technologies for solar, wind, anaerobic digestion, and gasification. A unique feature about this project is that it integrated Net Energy Metering Aggregation (NEMA), a program through the California Public Utilities Commission (CPUC) that enables agricultural communities to aggregate meters in a continuous property, with various other strategies to maximize the effectiveness of the Project Management Application. Development and testing was done in collaboration with four local jurisdictions in the Central Valley, the San Joaquin Valley Air Pollution Control District, and the US Navy.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

SB 350 (2015) sets a 50 percent renewable energy standard and a doubling of energy efficiency savings by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, and demand response. This project piloted innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

This project will reduce the time and costs needed to bring community-scale IDER projects to a shovel-ready state.

Economic Development:

This project will pilot new approaches that increase the financial attractiveness of community-scale IDER projects, which could lead to increased investment in the community.

Public Health:

Establishing a replicable model for the adoption of renewable energy generating technologies in the Central Valley can lead to an increase in air quality for not just that region, but all of California.

Consumer Appeal:

This project will conduct a case study documenting the steps required to deploy IDER solutions in farms and agricultural communities, creating a roadmap making it easier for similar communities to follow and adopt.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$122,540
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,175,919	$761,116

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:

City of San Joaquin: $25,000 (1.1 %)
Fresno Council of Governments: $25,000 (1.1 %)
PondelWilkinson: $25,000 (1.1 %)
Red Rock Ranch, Inc.: $25,000 (1.1 %)
San Joaquin Valley Air Pollution Control District: $47,500 (2.1 %)
Office of Community and Economic Development - CSU Fresno: $25,000 (1.1 %)
San Joaquin Valley Clean Energy Organization: $25,000 (1.1 %)
West Hills Community College District: $25,000 (1.1 %)
18Thirty Entertainment, LLC: $15,000 (0.6 %)
City of Huron: $25,000 (1.1 %)
Larry Alberg: $16,000 (0.7 %)
Dr. Stephen Kaffka: $16,000 (0.7 %)
Chelsea Teall, PE: $16,000 (0.7 %)
Leon Woods III: $16,000 (0.7 %)
Biodico, Inc.: $813,919 (35.1 %)</td><td colspan="2">Match Funding:

$1,140,419</td></tr>
<tr><td colspan="2">Leverage Contributors:

N/A</td><td colspan="2">Leveraged Funds:

$0</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-071 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:

This project concluded in March 2018. The project developed an interactive tool designed for farm owners called the Zero Net Energy Farm (ZNEF) GeoPlanner, which enables users to</td></tr>
</table>

assess the renewable energy potential of their property in meeting their specific energy needs. The ZNEF GeoPlanner enables users to estimate the cost and energy generation of various advanced energy technologies (such as solar, wind or biomass technology) geared specifically towards farms in California. An introduction to the ZNEF GeoPlanner is available at: http://www.zeronetenergyfarms.com/. Biodico used the ZNEF GeoPlanner to develop a Master Community Design at the Red Rocks Ranch in Five Points, California.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

New Chemical Compounds for Cost-Effective Carbon Capture

[EPC-15-072]

Recipient/Contractor:

The Regents of the University of California, Davis Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 1/1/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Although recent regulations will dramatically reduce greenhouse gas emissions, fossil fuels will remain fundamental to the California energy infrastructure for decades. Carbon capture can reduce the greenhouse gas (GHG) emissions from electricity producing facilities that rely on combustion of fossil fuels (coal, natural gas, and oil). Carbon dioxide (CO2) capture and sequestration (CCS) could play an important role in reducing greenhouse gas emissions, while enabling low-carbon electricity generation from power plants. The current CO2 capturing compounds make CO2 removal process very costly and produce additional waste.

Project Description:

This project uses computational chemistry to support the discovery and characterization of new chemical compounds that can safely and economically capture carbon dioxide (CO2) from the stacks of power plants and other large emitters.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project uses innovative ab initio quantum mechanical and molecular dynamics simulations to design and characterize carbon capturing compounds, mimicking processes previously discovered in plant existing in arid areas. The organic PEP compounds in these plants store and release CO2 in a similar manner as the currently used inorganic amines. Organic molecules unlike the inorganic, can be modified in a way, that would adjust their reaction enthalpy, solubility, viscosity, reaction rate to be an inexpensive, non-toxic substitute for amines in carbon capture.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 4a
Lower Costs:
Improved solubility of potential carbon capturing molecule in water instead of expensive organic solvents would result in significant cost savings if applied in large-scale carbon capture process.

Environmental Benefits:
A path for a drastic reduction of greenhouse gas emissions from fossil fuel burning energy systems could be developed upon completion of this agreement.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$40,000</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$200,000</td><td colspan="2">EPIC Funds Spent:
$80,947</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
45 out of 45 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 11: Ranked # 9</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-072 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The research team initiated simulation and optimization of candidate carbon capturing molecules using molecular dynamics modeling tools, including the plant process simulator Cape-Open to Cape-Open (COCO). After initial computational calculations, it was realized that COCO software will not provide the level of detail needed to draw well-founded conclusions regarding the suitability of phosphoenolpyruvate (PEP) compounds for carbon capturing and sequestration. A more sophisticated plant process modeling software, Aspen Plus, has been obtained to model thermodynamics and kinetic properties of potential carbon capturing compounds.

In early 2019, UC Davis in collaboration with EPRI will select the most promising compounds identified based on their calculated properties and model the carbon capture process in a typical electricity producing power plant.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Identifying Effective Demand Response Program Designs to Increase Residential Customer Participation

[EPC-15-073]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

As the state moves toward more distributed generation and intermittent renewable energy generation, there is a need for smaller resources to play larger roles in distribution and transmission grid management. The end-use loads enrolled in Existing Demand Response (DR) programs have high opportunity costs and participation is low. Some newly-developed market options, such as aggregation programs, could enable large numbers of small loads across multiple customers to participate in wholesale markets. However, participation logistics, including metering, verification and settlement, are barriers to wider participation.

Project Description:

This project is testing the effectiveness of innovative designs for demand response programs for residential customers using a behind-the-meter customer engagement platform developed by OhmConnect. Each of these innovative demand response strategies integrates a recent approach that energy researchers have shown to be effective in reducing customer consumption. These strategies include providing households with a) tailored energy-analytic feedback, b) aggregated versus single-period incentive information, c) non-financial environmental health benefit frames and d) social comparisons. An additional strategy is exploring how the timing of the delivered demand response information affects the magnitude of household participation and response.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will test the effectiveness of innovative design strategies for residential demand response providers and analyze different segments of the residential population including various socioeconomic groups and residential customers with photovoltaics and electric vehicles to see what incentives, messages and energy use information motivates reliable

participation in utility demand response programs. This information will expand knowledge in this area so that utility companies and regulators can build new and modify existing demand response programs to increase effectiveness. Accurate and reliable forecasts of participation in these programs will enable better utilization of existing generation resources and deferral of system capacity upgrades thereby lowering consumer electricity costs.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1h

Lower Costs:

This project could lower ratepayer costs through better utilization of existing electricity generation resources by having residential customers participate in demand response (DR) programs. System-wide this could reduce the need for high cost peaker plants during extreme climate events. Participants in the DR programs could be rewarded with incentives that would result in lower energy bills. One of the project goals is to learn what potential demand reduction could be achieved by optimizing the metrics of residential DR programs.

Greater Reliability:

Greater electric system reliability could be achieved through increased residential demand response program participation and having this contribute towards greater grid optimization, flexibility and lowering imbalances on the grid.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $203,115
EPIC Funds Encumbered: $2,007,875	**EPIC Funds Spent:** $1,136,736
Match Partner and Funding Split: Chai Energy: $288,853 (11.2 %) University of California Los Angeles: $273,780 (10.7 %)	**Match Funding:** $562,633

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 21 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 5</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
UCLA is working with its subcontractor, Ohm Connect, to analyze the effects of nonlinear incentives and baseline on customers and how it impacts their willingness to participate in Demand Response (DR) events. Nonlinear incentives are monetary rewards which increase exponentially with participation in DR events. The preliminary results are inconclusive which means that the data needs to be further refined with different variables. In addition, the analysis has shown that as the customer's baseline increases by 1 kWh there is an average of 0.2 kWh increase in their energy consumption during a DR event. This means customers would be more inclined to consume energy if they are given a large baseline because they would be able to get the incentive and still consume energy.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems

[EPC-15-074]

Recipient/Contractor:

Center for Sustainable Energy

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/18/2016 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

The State of California has established aggressive goals for incorporating behind-the-meter, customer-sited distributed energy resources (DERs) into the California wholesale energy markets, managed by the California Independent System Operator (California ISO). However, with only limited testing performed to date, the ability of DERs to simultaneously and cost-effectively meet onsite customer electrical needs while providing energy services into the California ISO market is largely unproven.

Project Description:

This project develops co-optimization strategies for distributed energy resources (DERs). The purpose is to maximize customer and system value under existing CPUC-approved retail and California Independent System Operator (California ISO) wholesale tariff structures, future market structures and pricing, and the transactive energy pricing signals developed under agreement EPC-15-054. The project tests and configures two DER portfolios: a) one consisting of large retail customers and schools using battery energy storage, solar photovoltaics, and integrated load management, and b) the other consisting of hotels using passive thermal energy storage, and energy efficiency. Both will be included as part of an integrated load management strategy capable of responding to price and reliability signals. The project team is also developing operational strategies for wholesale integration subject to the identified retail and wholesale tariffs and other operational constraints.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project is developing and testing strategies that customers, demand response (DR) aggregators, scheduling coordinators, and policy makers can implement to provide demand response that both meets grid needs and is acceptable to customers. The project will provide

comprehensive recommendations on how to overcome technical, institutional and regulatory barriers to facilitating DER participation in supply-side markets.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Energy storage: R.15-03-011 [Closed] Smart grid: R.08-12-009 [closed] Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1f, 1g, 1h, 3e, 3f

Lower Costs:

This project has the potential to lower energy costs for individual customers, as well as system costs for all ratepayers California ISO market participants. On the distribution circuit, demonstrated demand management capabilities can help defer cost of expensive capacity upgrade investments such as transformer or line upgrades.

Greater Reliability:

As the penetration of intermittent resources increases in California, energy balancing requirements increase as well. Behind-the-meter demand response and storage on the distribution system can increase distribution system reliability issues through services such as local overload relief, power quality and ramp-rate mitigation on circuits with high penetration of photovoltaics.

Increase Safety:

By deploying, testing, and validating system integration, metering, and telemetry, the project will contribute to the safe operation of DER systems in customer-sited locations while maximizing value for these systems to both customers and wholesale market activities.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Grid Operations/Market Design	$746,794
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$3,960,805	$1,632,876

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:
Solar City Corporation: $1,449,262 (24.4 %)
DNV GL: $2,000 (0.0 %)
Conectric Networks, LLC: $530,000 (8.9 %)</td><td colspan="2">Match Funding:
$1,981,262</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 21 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-074 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Subcontractor Conectric, LLC. will employ patented and unregistered IP in the operation of control systems being used to evaluate different load management strategies and customer impacts in this project.</td></tr>
<tr><td colspan="4">Update:
The project is on schedule. Agreements with Solar City (recently acquired by Tesla) to engage and operate the K-12 school sites equipped with solar PV, storage, and load management control capabilities have been finalized and market participation is underway. Installation of monitoring and control equipment at the hotel sites has been completed and audits, data collection, and operational testing are already yielding recommendations for efficiency improvements. The data are being analyzed for the purpose of developing effective DR strategies. Recently, the project expanded participation to the new CAISO ancillary services market.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Customer-centric Demand Management using Load Aggregation and Data Analytics [EPC-15-075]	
Recipient/Contractor: Electric Power Research Institute, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/18/2016 to 12/31/2019
Program Area and Strategic Objective: Applied Research and Development S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices	
Issue: Load management in buildings has been lagging for decades due to lack of technology that can reliably provide reductions while gaining customer acceptance. As the State moves toward high penetration of customer-sited renewables that increase the management challenges for grid operators, it is imperative that load management for large numbers of small customers become mainstream. The technologies to manage loads are rapidly being developed and deployed, but relying on privately-developed proprietary solutions carries the risk of inconsistent performance as well as customer confusion and dissatisfaction.	
Project Description: This project demonstrates how a large number of small electric loads, each impacted by and tuned to individual customer preferences can provide load management for both utilities and the California Independent System Operator (California ISO). The primary goal is to refine and demonstrate an open-source end-use management platform capable of operating reliably with all or most available end-use devices and thus defining a viable standard protocol to which all vendors can develop new products. The recipient works with an extensive spectrum of leading product providers covering all major distributed energy resources (DERs), such as Nest (thermostats), ThinkEco (plug loads), Honda and BMW (Vehicle Grid Integration), EGuana (smart Inverter) and Ice Energy (Thermal Storage). A variety of price signals are being tested for Time-of-Use customers such as Critical Peak Pricing and Demand Rate. The project is using deep analytics to evaluate individual customer preferences for demand management using microdata from devices and aggregate the responses to meet grid needs at different distribution and transmission levels.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is using low cost off-the-shelf technologies to develop a platform that can manage customer end-use devices according to their preferences, minimize their energy costs, and adapt to evolving tariff structures. By making the task of automating multiple end-use devices easier, less costly, and less of an imposition on customers, the project has the potential to increase demand response participation, with consequent benefits to the electric grid.

CPUC Proceedings addressing issues related to this EPIC project:

Self-Generation Incentive Program: R.12-11-005 Energy storage: R.15-03-011 [Closed] Smart grid: R.08-12-009 [closed] Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1f, 1g, 1h, 5c

Lower Costs:

Benefits include statewide residential electricity savings of approximately 1040 GWh per year and small commercial savings of 53 GWh per year for a total of 1093 GWh per year, which translates to estimated statewide CO2e reductions of 397,631 metric tons per year. The total annual bill reduction is approximately $8.21M for commercial facilities and $185M for residential buildings.

Greater Reliability:

The project has the potential to increase adoption of demand response programs from the current 15 percent to as much as 60 percent. Managing air-conditioning loads, plug loads, and electric vehicles could provide up to 12 GW of capacity that could be shifted to maximize utilization of renewable resources, provide ramping and other ancillary services, and contribute to greater grid flexibility.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $1,163,894
EPIC Funds Encumbered: $3,998,587	**EPIC Funds Spent:** $1,391,198
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $979,860 (18.6 %) InTech Energy, Inc.: $280,452 (5.3 %) Pedagogy World, Inc.: $10,000 (0.2 %)	**Match Funding:** $1,270,312

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 21 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

"Energy360 Power Monitoring, Analytics & Controls" software is pre-existing intellectual property trademarked by InTech Energy.

The Chai Energy Logo is trademarked project-relevant pre-existing intellectual property.

The Olivine DER Platform and the EPRI Smart Thermostat Collaborative Data are project-relevant, unregistered pre-existing intellectual property.</td></tr>
<tr><td colspan="4">Update:
The project is on track. The team is working with their key development partners to leverage the demand response scheduling interface with the CAISO market. The recipient continues to make progress on development of their energy information database and customer user interface requirements and testing and refining the messaging across all platforms.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Richmond Advanced Energy Community Project

[EPC-15-076]

Recipient/Contractor:

Zero Net Energy Alliance, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/13/2016 to 3/30/2018

Program Area and Strategic Objective:

Market Facilitation

S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure

Issue:

Due largely to limitations and challenges in design, financing, available professional expertise, and scale-up strategies, zero net energy (ZNE) communities have not yet been developed at a large scale, or applied to infill development. The majority of ZNE buildings have been deployed in more affluent areas that can afford the initially steep ZNE learning curve and higher-cost early-stage technologies. Streamlining the regulatory and financing aspects of ZNE deployment can lead to significant increases in similar developments throughout California.

Project Description:

This project provided technical assistance to the City of Richmond in the design and adoption of a comprehensive integrated policy and planning program, and a financing framework to facilitate adoption of advanced energy technologies needed to transform the City of Richmond into a ZNE Community. As part of this project, the project team identified unique challenges to disadvantaged communities and worked with local stakeholders, including the City of Richmond, to identify and implement specific strategies to overcome those challenges. These strategies will be piloted at the conclusion of this agreement as part of a redevelopment effort to convert 20 abandoned homes into affordable ZNE homes available for working families via the First-time Home Buyers' Program.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving the goal by helping facilitate community-scale deployment of Integrated Distributed Energy

Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

Streamlined planning and permitting, as well as new financial models will lower the time and capital costs associated with AEC developments. This will make AECs more affordable for both developers and consumers.

Increase Safety:

Increased safety will be achieved by: identification of hazards and ventilation defects during energy assessments conducted as a result of adoption of the Building Energy Saving Ordinance, (BESO).

Economic Development:

This project will pilot new approaches that increase the financial attractiveness of community-scale IDER projects, which could lead to increased investment in the community.

Consumer Appeal:

Greater deployment of AECs will increase consumer familiarity and comfort with ZNE homes and communities, increasing the likelihood of consumers choosing to live in an AEC.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $370,990
EPIC Funds Encumbered: $1,480,111	**EPIC Funds Spent:** $1,246,861
Match Partner and Funding Split: Energy Solutions: $500,084 (12.3 %) City of Richmond: $550,000 (13.5 %)	**Match Funding:** $2,590,134

<table>
<tr><td colspan="2">Olivine, Inc.: $40,050 (1.0 %)
Richmond Community Foundation: $1,500,000 (36.9 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-076 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project completed in 2018. The project team developed and updated several tools to help the City of Richmond roll out strategies to deploy new clean energy technologies. This included developing a rating system to streamline the City's process for evaluating projects to finance. In addition, this included enhancing the capabilities in the Green Revolving Investment Tracking System to streamline the City's administration of Green Revolving Fund and the Social Impact Bond that will be used to finance the advanced energy projects being proposed.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Huntington Beach Advanced Energy Community Blueprint [EPC-15-077]	
Recipient/Contractor: The Regents of the University of California, on behalf of the Irvine campus	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/15/2016 to 7/31/2018
Program Area and Strategic Objective: Market Facilitation S16: Collaborate With Local Jurisdictions and Stakeholder Groups in IOU Territories to Establish Strategies for Enhancing Current Regulatory Assistance and Permit Streamlining Efforts That Facilitate Coordinated Investments and Widespread Deployment of Clean Energy Infrastructure	
Issue: Electrical utilities face challenges with aging infrastructure and load capacity constraints that limit where certain technologies can be installed. Disadvantaged communities face their own set of challenges that often prevent their clean energy needs from being met. While integrated, community-scale systems that combine local renewable energy sources, energy storage, and control technologies could provide benefits to help the utility and community, new tools and approaches are needed to design these systems in a manner that meets the needs of both groups.	
Project Description: This project designed an integrated energy system to transform the disadvantaged Huntington Beach community of Oak View, into an advanced energy community (AEC). The team worked closely with ComUNIDAD, a community organization, to ensure the community needs were factored into modeling scenarios. The project team developed new design tools to simulate an integrated energy infrastructure on a community-scale, expanding the capability from the existing single-building design tools. The team evaluated multiple scenarios to determine the most optimal set of clean energy technologies and business and financial models to align the community's energy needs within the constraints of the existing electricity infrastructure.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving this goal by helping facilitate community-scale deployment of Integrated Distributed Energy	

Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project piloted innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

This tools and approaches piloted in this project will reduce the time and costs needed to design future community-scale IDER projects.

Economic Development:

This project piloted new approaches and develop new planning tools that can increase the financial attractiveness and overcome some of the common obstacles of deploying community-scale IDER projects, especially in disadvantaged communities. Combined, these can lead to increased investment energy savings and investment in the community.

Consumer Appeal:

Greater deployment of advanced energy technologies at a community scale will increase consumer familiarity and comfort with Zero Net Energy homes and communities. This will increase the likelihood of consumers choosing to live in communities deploying advanced energy technologies.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$508,226
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,500,000	$337,423
Match Partner and Funding Split:	**Match Funding:**
Southern California Edison: $200,000 (8.7 %) County of Orange/City of Huntington Beach: $152,900 (6.6 %) Altura Associates, Inc.: $62,000 (2.7 %) National Renewable Energy Laboratory (NREL): $200,000 (8.7 %) Southern California Gas Company	$810,998

<table>
<tr><td colspan="2">(SoCalGas): $150,000 (6.5 %)
The Regents of the University of California, Irvine Advanced Power and Energy Program: $46,098 (2.0 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project ended in July 2018. Using the UrbanOpt and DEROpt tools to determine the most optimal technical and economical suite of clean energy technologies, the team developed a master community design for the Oak View AEC. Because of the mild climate and limitations with aging building stock, the plan consists of the most impactful energy efficiency upgrades (lighting and plug-loads), as well as community-scale solar PV systems mounted on carports and rooftops, and energy storage. These systems were sized to reduce the overall electrical use by the maximum of nearly 94 percent. Finally, to encourage community acceptance, the team offered a ten-week STEM course to the elementary school's after-school program, and held a series of workshops to introduce residents to green energy concepts providing materials in Spanish and playing games familiar to the predominantly Hispanic community.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Risk Modeling and Cognitive Science Characterization of Barriers to Climate Change Adaptation in California Electricity Sector

[EPC-15-078]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	5/30/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Adaptation to climate change is critical to ensure a robust electricity system for California. However, little is known regarding system-wide effectiveness of current electricity sector approaches to managing climate change-related risks. Similarly, little is known regarding barriers faced by electricity sector stakeholders' implementation of adaptation measures. This research develops a framework for systematically identifying barriers to climate adaptation and develops a metric to evaluate the performance of California's electricity sector in terms of adaptation to climate change.

Project Description:

Researchers are developing a framework for assessing climate change risk and adaptation practices in the electricity sector, identifying perceived barriers to execution of resilience strategies, and delineating practices that are currently being implemented in the electricity sector. These initial activities form a basis for developing a dynamic model for long-term resilience planning that can identify optimal strategies to hedge against climate risks associated with future climate scenarios for California. The analysis also considers how independently initiated adaptation efforts perform relative to a system-wide strategy, with an eye toward identifying lingering electricity sector vulnerabilities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Researchers are developing methods to account for risks, plan for resulting adaptation, and account for the barriers that might exist in the system. The results of research are intended to improve on the general knowledge of framing climate-related policies under uncertainty and to examine all aspects of the adaptation planning process: decision-makers involved, stages of decision processes, and the institutional contexts where the decision-makers develop the

decision processes. The results can inform technology choice investment and deployment, to the extent that those choices are made with consideration of climate risks.

CPUC Proceedings addressing issues related to this EPIC project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 2a, 3e, 3h

Lower Costs:

The research results may be used to improve on policies by ensuring the affordability of electricity production. The financial and operational-risk minimization method developed for this study is focused on eliminating barriers to climate change adaptation, ensuring affordability of the production and supply side due to better planning and accounting for extreme events.

Greater Reliability:

The proposed work is providing a better understanding on how and where adaptation is needed, as a function of uncertain climate change predictions, and barriers that are likely to arise and thus will ensure the resilience and greater reliability of the power sector in the face of extreme events.

Assignment to Value Chain: Grid Operations/Market Design		**Total Budgeted Project Admin and Overhead Costs:** $48,887	
EPIC Funds Encumbered: $350,000		**EPIC Funds Spent:** $177,177	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 8: Ranked # 1

APPENDIX B:
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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-078 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research has undertaken ratepayer surveys and review of administrative documents filed with the State of California to shed light on adaptation barriers, as well as how climate-related risks have been incorporated into recent planning and decision-making processes. Additionally, the team has explored how processes associated with climate change-- such as changes in temperature and/or precipitation patterns-- could be incorporated into planning and decision-making processes through quantitative modeling. The research team is currently working to engage a TAC comprised of utilities, researchers, and other electricity sector stakeholders in review of its draft deliverables.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Advanced Renewable Energy Storage and Recycled Water Project [EPC-15-079]	
Recipient/Contractor: Victor Valley Wastewater Reclamation Authority (VVWRA)	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/13/2016 to 3/31/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies	
Issue: Several California wastewater treatment plants have on-site power generation systems fueled by biogas. However, many of these systems are unable to respond to variable onsite electrical loads and this can result in tripping off a facility's wastewater treatment equipment. This results in shut downs of the onsite power generation system resulting in increased power costs and reliance on grid power and a corresponding reduced ability to produce recycled water. An effective power control system is needed to demonstrate that it can reliably collect and store excess renewable electricity generated on site and reduce the cost and increase the availability of producing recycled water.	
Project Description: The Victor Valley Wastewater Reclamation Authority (VVWRA), in partnership with Primus Power, University of California Riverside (UCR), and Anaergia, is demonstrating an advanced, pre-commercial flow battery storage and control system at VVWRA's existing Regional Wastewater Treatment Plant, located in a disadvantaged community outside of Victorville. The project deploys Primus Power's ENERGYPOD flow battery system in a 240 kW/1,200 kWh configuration, managed by a UCR-designed controller system that is optimized specifically for management, generation and storage of renewable energy power. The project hopes to alleviate rapid fluctuations in the wastewater treatment plant's power demand that causes disruption of the disinfection system used to treat recycled water to California standards, resulting in the disposal of approximately 2.5 million gallons of water annually.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project demonstrates an advanced battery storage and control system coupled with on-site renewable energy generation and its ability to control rapid changes in on site power demands. If successful, this project could reduce grid power demand and reduce energy costs to wastewater treatment plants and alleviate disruptions in recycled water production due to high variability of on-site power loads which can cause partial treatment shutdowns. The project results could be applicable to other wastewater treatment and industrial plants in California.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1h, 3c, 4c

Lower Costs:

This project uses a battery storage system combined with an advanced controller to enable the wastewater treatment plant to accommodate variable loads, increase onsite renewable power production, and substantially reduce its reliance on grid power. This project could reduce annual grid power demand by 4.2 million kWh or nearly $473,000 in cost savings to the treatment plant.

Economic Development:

Stored power will be used to meet peak demand on site with 100% renewable energy, reducing grid power consumption by 4,213,416 kWh/yr.

Environmental Benefits:

Under the project, equipment tripping off due to power fluctuations would be curtailed, enabling reuse and water savings of approximately 2.5 million gallons per year. This water could be used by the community in place of fresh water sources.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $220,423
EPIC Funds Encumbered: $1,734,059	**EPIC Funds Spent:** $1,036,307
Match Partner and Funding Split: Victor Valley Wastewater Reclamation Authority (VVWRA): $773,014 (29.3 %) Primus Power Corporation: $129,201 (4.9 %)	**Match Funding:** $902,215

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 27 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 2
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: The recipient is running tests on the project controller and integrating with the two batteries and other components. The recipient is continuing work on the microgrid control system and onsite testing of the mechanical systems.			

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Interdependencies of Electric Grid and Critical Lifelines: Identifying Climate Exposure and Adaptation Strategies

[EPC-15-080]

Recipient/Contractor:

Thalassa Research & Consulting, LLC

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 1/17/2018

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Climate vulnerability assessments in the energy system by utilities have thus far only examined hazards that the utilities are familiar with and that are proximate to their assets. However, what is known from natural disaster research is that hazards can have cascading impacts across sectors. To protect the energy sector from climate disruption, it is crucial to develop tools and methodologies to investigate non-proximate catastrophic and cascading risks in a geographically and context specific manner. This research is a first step in developing such methodologies and tools for the greater Los Angeles region.

Project Description:

This pilot study for electricity sector climate adaptation involves vigorous stakeholder engagement and systems analysis to identify and systematically account for cascading impacts internal to and outside of the electricity sector as well as resilience options. These cascading impacts include climate impacts to supply chains for electricity generation and distribution, disruption to telecommunications that the electricity sector relies on in emergencies, and other impacts that may be initially felt far away but have consequences for California's electricity system. One example of supply chain interruption is that manufacturing facilities in East Asia that produce 500kV transformers, which the California distribution system relies on, are susceptible to flooding and other extreme events linked to climate change. This study pilots a systematic framework for assessing such long-distance linkages that can disrupt electricity services and cause ripple or cascading effects on critical infrastructure in the Greater Los Angeles region. Findings from this project, which includes many diverse stakeholders, could be used to inform planning in other areas of the state.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

APPENDIX B:
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The research will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by addressing challenges in the state's largest metropolitan area -- the study of societal teleconnections. Societal teleconnections are human-created linkages that connect activities, trends, and disruptions across large distances such that locations can experience negative impacts from faraway places. This study is producing new tools and techniques to assist communities to incorporate climate impacts that are non-local in origin into their traditional climate adaptation and hazard planning. This is the first time that a systematic approach to exogenous risks is being taken for an urban area.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 2a, 3a, 3e, 3g, 4a

Increase Safety:

The tools created in this study, which are being pilot tested in the greater Los Angeles area, can be used to protect the safety of electricity infrastructure from cascading impacts of climate change related events across sectors.

Public Health:

Public health benefits from this study come from mapping the consequences of interlinked hazardous events across sectors to critical infrastructure that protects public health and safety.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $128,188		**EPIC Funds Spent:** $128,163	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 45 out of 45 bidders	**Rank of Selected Applicant/ Bidder:** Group 11: Ranked # 3

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-080 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Drawing on extensive stakeholder engagement in 2016 and 2017 as well as interactive system modeling, researchers published a final, peer reviewed report as part of California's Fourth Climate Change Assessment. Cross-cutting findings include that energy and telecommunication are critically connected to each other and to other lifelines; emergency management and public health services depend on inputs from all lifelines to be effective; workforce availability is crucial to the ability to respond effectively, but it is already limited and dependent on many different upstream lifelines; and maintaining a state of good repair on all equipment is essential to smooth functioning of all lifelines. Opportunities to advance resilience of interdependent lifeline systems include open data policies, adaptation planning mandates, and engagement at regional levels to consider extreme scenarios.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Historical Insights for Electricity Transition Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity

[EPC-15-081]

Recipient/Contractor:

Ghoulem Research

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/13/2016 to 6/28/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

Energy and climate change planning depend on anticipated changes in actual use of technology. Energy sector planning to meet challenges of climate change must incorporate lessons from historical technology transitions. One area in which an ahistorical perspective of energy planning prevails is in demand forecasting models. Demand forecast models provide rough approximations of future household energy use and carbon emissions, but do not treat the dynamism and diversity of residential demand in any detail. Climate change policy requires dynamic, flexible simulation tools to address a range of questions about complex social-technological-environmental system dynamics in uncertain conditions.

Project Description:

Analysis of quantitative and qualitative data sheds light on histories of key energy technology changes, planned and unplanned. Interpretation of these histories will provide examples, principles and insights that can be used in future planning. The research team is producing example scenarios that illustrate the differences that these insights can make in planning and technology design. This research pays particular attention to developing and disseminating this information in usable ways, via dialogue with policy makers and planners, and through communications with other stakeholders. Leveraging insights from historical technology transitions, the research team is designing, deploying and testing a flexible modeling platform with which researchers, utilities, and Energy Commission demand modeling and forecasting staff can draw upon the best available empirical data to simulate dynamic residential demands for AC. This model serves as a proof of concept that might later be broadened to other energy uses and demand sectors.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Results improve the state's ability to estimate timing of technology penetration and accrual of benefits, and costs of desirable residential sector technologies. These results are key to improving the performance of efficiency measures outlined in AB 758 and the California Energy Code. They also support goals of CPUC's Energy Efficiency Strategic Plan, and inform updated estimates of timing and benefits as appropriate. Results portraying penetration and performance of key technologies (e.g., A/C) are expected to be of direct use in the scenario development and demand forecasts used in the Integrated Energy Policy Report.

CPUC Proceedings addressing issues related to this EPIC project:

Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed]

Applicable Metrics: CPUC Metrics- 5c

Greater Reliability:

This project improves energy demand forecasting, which will lead to greater electricity reliability and lower long-run costs by offering more accurate dynamic models that will result in more effective programs and policies, fostering beneficial technology transitions.

Environmental Benefits:

The study will result in a rigorous model that enables exploration of the human dimensions that could hinder or enable the technologies that are essential in the transition to a deeply decarbonized electricity system.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $400,000	**EPIC Funds Spent:** $0
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	45 out of 45 bidders	Group 11: Ranked # 4
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-081 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: The research team convened in-depth discussions with members from the Energy Commission's Demand Analysis Office, Supply Analysis Office, Building Standards Office, and Research Division to ensure that their modeling and historical energy transitions efforts address needs in those areas. The research team also developed a first-cut implementation of a "Simulation Sandbox", or prototype model to enable exploration of impacts of a number of human dimensions (e.g., behavior, policy, trends in AC adoption) on residential air conditioning demand. Finally, the team has been in conversation with two utilities regarding possible partnerships involving data sharing.			

APPENDIX B:
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Project Name:

Low-Temperature Microplasma-Assisted Hydrogen Production from Biogas for Electricity Generation

[EPC-15-082]

Recipient/Contractor:

The Regents of the University of California on behalf of the Merced Campus

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/1/2016 to 6/24/2019

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts

Issue:

With the growing concern about greenhouse gases and the resulting effects on the environment and public health, including long-term effects such as climate change, there is an emphasis on clean fuels that do not generate harmful pollutants to produce energy. Therefore, low-cost efficient hydrogen (H2) production from renewable sources such as biogas is an important challenge that needs to be addressed if hydrogen is going to play a major role in satisfying our future clean energy needs.

Project Description:

The purpose of this project is to demonstrate operation of a low-temperature microplasma reactor that will lead to an efficient, electricity-based technique to convert a mixture of carbon dioxide and methane into hydrogen for use in electricity generation. If successful, this technology could be adapted to use other gas inputs in the creation of hydrogen, such as products from the gasification of biomass.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Researchers will determine the appropriate operating parameters of microplasma array reactors for maximum efficiency in the biogas to syngas conversion process to produce clean electricity from renewable resources while simultaneously consuming greenhouse gases (in this case CO2), and, thereby, reducing the impact of electricity generation on the environment and climate.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 4a
Environmental Benefits:
The production of syngas from a biogas using a low-temperature microplasma is more energy-efficient compared to a syngas production by gasification or pyrolysis and would allow for energy savings. Furthermore, syngas from renewable resources produces very low emissions and reduces the carbon footprint from electricity generation.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$35,171</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$200,000</td><td colspan="2">EPIC Funds Spent:
$38,380</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
The Regents of the University of California, Merced: $47,199 (19.1 %)</td><td colspan="2">Match Funding:
$47,199</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
45 out of 45 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 11: Ranked # 5</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The research team installed and tested the low temperature microplasma reactor using a mixture of inert gases, such as argon and nitrogen, to ensure safe operation. Scientists performed experiments for plasma-assisted conversion of pure methane, pure carbon dioxide</td></tr>
</table>

and a 50/50 mixture of methane and carbon dioxide. The researchers analyzed gaseous products of conversion process using gas chromatograph. Future and on-going experiments for different CO2/CH4 ratios will help to better understand factors influencing conversion rate and selectivity.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Empowering Proactive Consumers to Participate in Demand Response Programs [EPC-15-083]	
Recipient/Contractor: OhmConnect, Inc.	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 5/18/2016 to 6/28/2019
Program Area and Strategic Objective: Applied Research and Development S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices	
Issue: The market for third-party demand response (DR) is constrained, severely limiting non-utility resources from contributing to the electricity grid. Although a bi-directional grid is now technically possible, neither prosumers (customers who both draw from and contribute to the grid) nor their devices can be integrated into the energy markets. A chicken and egg situation exists where policymakers and regulators will not open up the market for non-utility energy sources, citing a lack of customer interest, while customers remain unaware of how to contribute to the grid.	
Project Description: This project contains three elements to provide data for policymakers and businesses to explore this new market. First, this project determines prosumer (producer/consumer) interest in a third-party demand response market by testing user acquisition via direct and non-direct engagement strategies. Second, experimentation with behavioral and automated users allows analysis of user yield under a variety of conditions and extract a set of shadow curves that can inform how much energy load shifting can be expected under various price incentives. Finally, this project creates a novel solution for using residential telemetry to connect prosumers and their Internet of Things (IoT) devices to the market operators.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project is providing critical evidence that residential customers are willing to manage their electric loads for the purpose on meeting grid needs when presented with the meaningful, actionable information and salient incentives. The approach makes use of multiple social media platforms for communication and has developed multiple virtual customer "experience" opportunities using those platforms that enhance participation and keep customers interested and involved. The project provides conclusive evidence that with	

the appropriate approach, residential customers can and will adapt their energy use to a grid that depends heavily on variable renewable generation. This evidence can be used to help policymakers and regulators develop more effective direction for utility tariff and program design as well as program parameters for third party aggregator participation in demand response.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 California Solar Initiative: R.12-11-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1f, 1g, 1h, 3e

Lower Costs:

This project could reduce electricity costs for participants, permanently reduce the economic overhead associated with interfacing with new grid edge technologies, reduce peak demand on California's energy generation facilities, avoid peak demand energy costs, and provide crowdsourced grid services to meet increased demand, rather than relying on construction of new fossil generators.

Greater Reliability:

This project could reduce the complexity for grid-edge resources such as renewables and storage to be grid assets, thereby increasing the pool of accessible grid resources, stabilizing the grid by more effectively coordinating demand and supply resources, and enabling grid services to be crowdsourced to balance increased demand.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$33,903
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$3,995,028	$2,738,155
Match Partner and Funding Split:	**Match Funding:**
Schneider Electric USA Inc.: $120,000 (2.0 %) Honeywell, Inc.: $164,000 (2.8 %) OhmConnect, Inc.: $1,593,378 (27.1 %)	$1,877,378

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Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 19 out of 21 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 3
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-083 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. OhmConnect has built a user experience when registering, engaging, and interacting with the OhmConnect product. This user experience will be modified in ways to incorporate this project's goals for a subset of users. Those modifications are not covered in this Intellectual Property. During this project, certain portions of this user experience will be exposed in various contexts to the CEC.			
Update: This project is on track. Over 450,000 utility customers have signed up with OhmConnect, and about 35,000 of those participated in the experimental treatments conducted under the EPIC grant. The recipient completed the work to incorporate numerous different transactive signals, including the utility, the CAISO, and EPRI. ">The recipient has completed the preliminary data modeling and has been successfully bidding into and winning contracts to provide DR to the CAISO when dispatched through the Demand Response Auction Mechanism. The draft final report is anticipated in December 2018 and the project is on track for completion in the first quarter of 2019.			

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Project Name: Total Charge Management: Advanced Charge Management for Renewable Integration [EPC-15-084]	
Recipient/Contractor: Bayerische Motoren Werke of North America, LLC	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/30/2016 to 3/31/2020
Program Area and Strategic Objective: Applied Research and Development S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices	
Issue: Smart charging is a means of managing charging within a particular charging or parking event, usually at work during the day or at home during the night. The future electricity grid will face new balancing needs that change throughout the day and night as utilities and grid operators attempt to align renewable generation with customer load. As the grid becomes more dynamic, optimizing vehicle charging will require moving charging from night to day, from hour to hour, or from one grid location to another. California's steadily increasing electric vehicle population with larger capacity batteries combined with the mandates for more renewables require more means for managed vehicle charging.	
Project Description: This project explores the benefits and opportunities of Total Charge Management, where electric vehicle charging is managed across multiple charging events to maximize vehicle load flexibility. The project tests how flexible electric vehicle load can be if managed across a driver's daily or weekly charge events. This flexibility utilizes several pricing mechanisms to estimate the benefits of the Total Charge Management approach. The research develops and evaluates advanced vehicle telematics for utilities and grid operators to align vehicle battery status, driver mobility needs and grid conditions. Collaboration between the grid and the driver can yield a charging load profile that minimizes energy costs by aligning daily and weekly charging events to best meet grid needs.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will help the state advance the flexibility of electric vehicle charging as a flexible grid resource and vehicle charging cost savings to the driver. Optimal charging load patterns will be identified that can capture ratepayer and grid benefits using a variety of grid price signals. The project will pioneer demand response and smart charging technology	

advancement of not only the temporal benefits of controlled charging, but also the possible benefits that can be derived from being able to influence the location of charging.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1g

Lower Costs:

The cost of Plug-in Electric Vehicle (PEV) ownership is estimated to fall by $500 per year through grid service payments and reduced electricity bills for PEV drivers through managed charging. In total, this would provide $4,000 in savings over the 8-year ownership life of a typical vehicle.

Greater Reliability:

Total Charge Management would represent a resource of over 10,000 MWh per day. If 40 percent of that load could be flexibly managed, the following benefits would be realized every day: 3,000 MWh of solar-following load (enough to accommodate 4 million additional solar panels on the grid), and 1,200 MWh of wind-following nighttime load.

Environmental Benefits:

Aligning vehicle charging with renewable energy generation has the potential to reduce carbon emissions associated with vehicle charging by as much as 660,000 metric tons per year, at a scale of 1.5 million vehicles.

Energy Security:

Greater energy security comes from having more diverse distributed resources able to respond to grid needs. The Total Charge Management approach helps utilities and CAISO get more functionality out of electric vehicle load as a grid resource, which contributes to energy security.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $207,398
EPIC Funds Encumbered: $3,999,900	**EPIC Funds Spent:** $1,034,708
Match Partner and Funding Split: Kevala, Inc.: $33,545 (0.8 %) BMW of North America, LLC: $378,386 (8.6 %)	**Match Funding:** $411,931

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 21 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The existing iCharge Forward program developed trade secrets related to the vehicle telematics system and software used to administer grid service functionality between BMW's software backend and BMW electric vehicles. These trade secrets will be applied in this CEC project.</td></tr>
<tr><td colspan="4">Update:
BMW optimized their smart charging using grid pricing and constraints tests for residential night time charging with 50 drivers, which will guide the expansion to away-from-home charging and daytime charging (locational marginal pricing and renewable generation). Kevala (subcontractor) developed and integrated a tool to identify the subLAP (sub-load aggregation point) and LMP node locations to facilitate vehicle charging management when vehicles are away from home. BMW identified, permitted, and installed four energy storage systems to begin implementing the energy storage and combined use cases. The project team completed a distribution constraint analysis to inform use case implementations in 2018. BMW presented a project overview, methodology, and preliminary results to partners in Europe.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

San Diego Libraries Zero Net Energy and Integrated Demand Side Management Demonstration Project

[EPC-15-085]

Recipient/Contractor:

Center for Sustainable Energy

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California has set goals for 50% of existing publicly-owned municipal buildings to be Zero Net Energy (ZNE) by 2025, and for 50% of existing commercial buildings to be ZNE by 2030. Public agencies are in a unique position to demonstrate ZNE and integrated demand side management solutions, and to share lessons learned to spur growth in these markets. Cost-effective pathways to achieving ZNE through energy efficiency paired with controlling electric demand are not widely proven. Further demonstration and analysis is needed to determine market viability and long-term sustainable savings, particularly in the municipal sector.

Project Description:

This project is a partnership with the city of San Diego to bring ZNE to three libraries. It integrates pre-commercial energy efficiency measures, building automation, control systems, and behind the meter solar photovoltaic to retrofit three existing public libraries in San Diego.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Combining energy efficiency and building automation with solar photovoltaics can result in an integrated approach capable of meeting the state's energy efficiency goals and providing demand response to provide grid flexibility. As the commercial sector, and local governments in particular, are risk averse, being able to demonstrate an integrated approach as well as document performance, benefits, and costs without disrupting municipal operations is key to encouraging greater adoption of the technologies. The successful implementation of technology will help other local governments and the commercial building industry budget, plan and prioritize these types of projects for existing building ZNE upgrades leading up to the state's 2030 requirements.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project: Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]
Applicable Metrics: CPUC Metrics- 1e, 1f, 1h Lower Costs: The project could reduce energy and demand costs by integrating a package of energy efficiency and demand reducing technologies. CSE estimates that the project will save the City of San Diego approximately $75,000 annually, collectively. Greater Reliability: The presence of onsite renewable energy generation coupled with integrated efficiency and management technologies will allow commercial and municipal buildings to reduce grid consumption and shift load usage during peak energy demand. Results of the project will allow the commercial sector to increasingly participate in demand response programs that increase grid reliability and provide additional revenue for participating customers. Environmental Benefits: The project could potentially reduce building electricity consumption by approximately 932,000 kWh per year and reduce utility requirements to meet peak demand with fossil fuel powered peaker plants. This can potentially offset approximately 531,000 pounds of CO2e per year. Public Health: The reduced energy consumption from the libraries will offset 186 lbs of NOx per year and help mitigate the energy impacts of providing "cool zone" services to the community during extreme temperature days in the summer months.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $313,516
EPIC Funds Encumbered: $2,715,516	**EPIC Funds Spent:** $755,233
Match Partner and Funding Split: San Diego Gas & Electric Company: $60,000 (1.8 %)	**Match Funding:** $543,568

<table>
<tr><td colspan="2">City of San Diego: $482,000 (14.8 %)
San Diego Green Building Council: $1,568 (0.0 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 5: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Baseline energy monitoring has been completed for all three library sites. The PV system was installed at all library sites. Work is underway to identify the energy efficiency measures to be installed at the three library sites. Installation is expected to be completed by June 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Substation Automation and Optimization of Distribution Circuit Operations

[EPC-15-086]

Recipient/Contractor:

The Regents of the University of California, Irvine

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/22/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

To meet California's energy and environmental goals, it is necessary to increase the penetration of distributed energy resources. These resources are controlled and operated individually and, as a result, may fail to achieve their full potential or create problems in the distribution system. The ability to control these resources as a group could overcome their challenges and enable this group to participate in wholesale markets. To provide the management and control needed to achieve these capabilities, detailed modeling and simulation of the dynamics of the system at the distribution level are required.

Project Description:

This project will develop a Generic Microgrid Controller (GMC) to allow electrical substation control over grid assets, including generation resources, energy storage, and controllable loads. This will improve grid management at the distribution level. The team will assess different tariffs and interconnection agreements for a portfolio of scenarios to address the participation of distributed energy resources (DERs) in the market. In addition, a fictitious retail/distribution market will be developed and assessed.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will lead to technological advancement and breakthroughs by developing a control strategy to manage high penetrations of distributed energy assets (including generating resources, energy storage and controllable loads) as a single unit at a substation. The GMC will manage dispatchable loads and generation, reducing stress on the grid by shedding unnecessary loads and dispatching generation as required. The GMC also includes an economic dispatch feature that determines the least expensive solution to serve all the loads.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1g, 3a, 3f, 5f

Lower Costs:

The controller will optimize dispatch of the available resources on the distribution system, which will lower operation costs by dispatching and utilizing available assets so they will neither be stranded nor under-utilized.

Greater Reliability:

The controller provides visibility into the distribution system and will enable the operators to identify any issues quickly and respond to maintain system reliability.

Increase Safety:

Enhancing automation and control capabilities of a substation allows for quick resolution of safety issues. Controlling load further allows for ensuring that the critical loads are being served in case of an emergency.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $124,021
EPIC Funds Encumbered: $932,718	**EPIC Funds Spent:** $592,300
Match Partner and Funding Split: OPAL-RT Corporation: $35,978 (3.4 %) The Regents of the University of California, Irvine Advanced Power and Energy Program: $76,303 (7.3 %)	**Match Funding:** $112,281
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 23 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-086 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: UC Irvine completed the development and testing of a GMC, in partnership with Southern California Edison (SCE). The GMC can be applied at the substation level to control distributed energy resources on the circuits to benefit grid stability. The controller was applied to the SCE MacArthur substation and two circuits fed by this substation. The GMC was used to control and optimize the DERs on the distribution system. The controller enabled more DERs to be added on the distribution system. A retail market was simulated and various tariffs were evaluated to determine benefits to developers, utilities, and grid stability.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Cooling Tower Water Treatment using Vortex Process Technology for Energy and Water Savings

[EPC-15-087]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 12/31/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Chemical water treatment systems used to reduce scaling and inhibit biological degradation have typically been used in large central plants, industrial refrigeration plants, and other large cooling systems. Non-chemical treatment systems have the potential to reduce consumption of water by allowing more cycles of concentration in this equipment, as well as reducing the quantity and toxicity of discharge to wastewater treatment plants. The Vortex Process Technology has the potential to increase energy efficiency and reduce water use but there are uncertainties associated with long term performance, effectiveness, energy savings and cost effectiveness.

Project Description:

This agreement is funding the full-scale deployment demonstration of the Vortex Process Technology in cooling towers of commercial buildings. This technology has been used successfully in Europe and will be testing in California to address state specific goals for water and energy savings.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Non-chemical water treatment has the potential to reduce water use, improve quality of water discharged to wastewater stream, reduce scaling in condenser water piping, and increase energy efficiency of chilled water plants. The Vortex technology removes calcium carbonate from recycled cooling water and improves viscosity. By removing calcium carbonate physically it reduces the amount of chemicals used in calcium removal methods.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4c, 4d, 4e

Lower Costs:

This project has the potential to reduce energy and water costs in commercial buildings. The energy savings is due to improved cooling tower efficiency and heat transfer in cooling equipment. This project is estimated to reduce electricity use by 3 to 5 percent, excluding embedded energy savings from reduced water pumping and water treatment. The water savings is due to allowing higher cycles of concentration and supply water usage.

Increase Safety:

Reduces use of hazardous chemicals, thereby reducing exposure of maintenance personnel.

Environmental Benefits:

As less chemical are used in the treatment of the water in cooling towers, this could reduce discharge of toxic materials into wastewater stream.

Public Health:

Reduces exposure to toxic chemicals related to their manufacture, transport, handling, and disposal or use.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $485,121
EPIC Funds Encumbered: $1,999,995	**EPIC Funds Spent:** $1,085,309
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $324,990 (13.3 %) Cypress LTD: $125,000 (5.1 %)	**Match Funding:** $449,990
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 35 bidders	Group 2: Ranked # 6

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-087 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The Vortex Process Technology (VPT) has been installed and operational at both host sites with continued data collection and monitoring. Significant water savings are being achieved at both sites as the cooling tower cycles of concentrations are increased. In the case of Amgen, the Cycles of Concentration (the makeup water and blowdown water per unit of cooling) have increased from 3.4 prior to the VPT system installation to 7.0, which resulted in savings of 18% in makeup water from Aug 2017 to July 2018. The two sites are Amgen in Thousand Oaks, CA and The Westin Hotel in Rancho Mirage, CA. Preliminary analysis shows 2.5 - 4 percent energy savings at the Amgen site.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Biofiltration as an Advanced Primary Treatment Method to Achieve Substantial Energy Savings

[EPC-15-088]

Recipient/Contractor:

Kennedy/Jenks Consultants, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

The secondary biological wastewater treatment process method is accomplished by aerating wastewater and is very energy intensive, typically accounting for 40 to 60 percent of the total wastewater treatment plant (WWTP) electricity consumption. Achieving a higher amount of removal of organic material before the aerated activated sludge process provides a breakthrough opportunity to reduce electrical power demand. However, biofiltration as an advanced primary treatment method is an emerging technology for removal of total organic load, both soluble and particulate material, and has never been implemented full scale at WWTPs.

Project Description:

The project is demonstrating that Biofiltration is a technically viable and commercially attractive approach to achieve significant electrical energy savings at wastewater treatment plants. This project is quantifying the electrical energy reduction and water savings that can be achieved by Biofiltration based on demonstration results at the Linda County Water District plant. This project will provide the cost and performance data to evaluate the benefits from a sustained, full scale validation testing, including quantification of electrical energy savings, determination of water savings, organic solids removal efficiencies, operation and maintenance and design criteria, independent monitoring and verification and technology transfer.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Biofiltration as an advanced primary treatment method could reduce the aeration electrical energy needed for secondary treatment, increase energy production in the anaerobic digester from the removed organic material and increase existing secondary treatment

<table>
<tr><td colspan="4">capacity and forestall the need for future treatment plants. Based on pilot studies outside of California, Biofiltration has the potential to decrease aeration power by 45 to 60 percent, increase gas production from 25 to 40 percent and increase treatment capacity by 50 percent.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 4c
Lower Costs:
Aeration power requirements are estimated to decrease by approximately 45 to 60 percent compared to conventional treatment methods. Assuming 25% implementation of the technology, it is estimated that the annual electrical energy and cost savings for the wastewater treatment plant operators in California will be 110,000,000 kWh and $12,900,000 per year, respectively.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$442,698</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,306,185</td><td colspan="2">EPIC Funds Spent:
$340,641</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Professor George Tchobanoglous, Ph.D., P.E.: $12,000 (0.8 %)
WesTech, Inc.: $194,050 (12.3 %)
Linda County Water District: $24,700 (1.6 %)
Kennedy/Jenks Consultants: $41,000 (2.6 %)</td><td colspan="2">Match Funding:
$271,750</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement</td></tr>
</table>

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Terms and Conditions. The method for backwashing the FlexFilter as well as the unique nature of the engineered bladder that provides a porosity gradient are both patented features of the FlexFilter. The applicable US Patent numbers are 7,223,347 7,143,781 as well as 7,435,351 and application 13/534,822. Any design criteria or specific information about the pilot unit must remain confidential.
Update: Kennedy/Jenks completed installation in July 2018 and have been operating the biofilter at the Linda County Water District site. They are currently working on updating the electrical work for alarms and controls.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Expanding Standards and Developing Tools to Enable DNP3 Support of Energy Storage Use Cases

[EPC-15-089]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/22/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Operational Tools, Models, and Simulations to Improve Grid Resource Planning

Issue:

For smart inverters to communicate effectively with a variety of distributed energy resources, there needs to be a standard communication protocol. There has been significant development of DNP3 (Distributed Network Protocol) for smart inverter functions, but that has focused on communicating with solar photovoltaic systems. There is a need to expand and refine the DNP3 protocols to standardize communications to control energy storage functions.

Project Description:

The recipient is developing tools to make adoption of DNP3 for communication and control of energy storage systems simple and seamless. The approach is to evaluate the current state of communications to DERs and address any gaps in functionality, work with the DNP3 Users Group to update the existing energy storage and solar specifications to support the most advanced energy storage use cases, create an open-source DNP3 client to simplify product development of smart inverters, and develop the appropriate conformance testing tools to ensure interoperability.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will advance the DNP3 protocol (communication standards for smart inverters) by making it simple and seamless while also improving communications with stand-alone energy storage systems and control of other inverter-based devices. This will allow California to utilize more energy storage systems; thus, increasing the use of renewables and other DERs to support a more flexibility grid.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed] Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed]

Applicable Metrics: CPUC Metrics- 1a, 1h, 1i, 2a, 3a, 5a

Greater Reliability:

This project will expand the capability of utilities to control energy storage systems, which will allow them to maximize the use of energy storage systems to provide a more reliable grid.

Environmental Benefits:

Environmental benefits of this project would stem from realizing the advanced use cases for energy storage that help reduce peaks and minimize the need for generators to provide support at peak times, which will reduce the state's greenhouse gas emissions and improve air quality.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $187,517
EPIC Funds Encumbered: $873,516	**EPIC Funds Spent:** $440,161
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $105,228 (8.5 %) MESA Standards Alliance: $75,000 (6.1 %) SunSpec Alliance: $130,100 (10.5 %) Xanthus Consulting International: $50,500 (4.1 %)	**Match Funding:** $360,828
Leverage Contributors:	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 23 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-089 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The team solicited input from a 150+ person international advisory group representing utilities, manufacturers, and researchers to identify gaps in the protocol for energy storage. The project team then developed coding to help address the gaps and applied the newly identified coding to the existing protocol used by utilities to control large scale storage systems. Additionally, the updated protocol was finalized in August 2018. The team is currently performing conformance testing with other standards and will streamline the adoption of this update through tech transfer, open source tools, and compliance testing.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Integrated Distributed Energy Resources Management System (iDERMS) [EPC-15-090]	
Recipient/Contractor: The Regents of the University of California (UC Riverside)	
Investment Plan: 2012-2014 Triennial Investment Plan	**Project Term:** 6/22/2016 to 1/31/2020
Program Area and Strategic Objective: Applied Research and Development S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020	
Issue: The number of distributed energy resources (DER), such as solar photovoltaic panels, electric vehicles, energy storage devices, and flexible loads has increased exponentially in the past few years. Traditional distribution automation systems designed under a centralized control scheme can no longer handle the task of coordinating the control of thousands of heterogeneous devices. Better control solutions are needed to enable grid reliability as DER deployment increases.	
Project Description: This project is developing an Integrated Distributed Energy Resource Management System (iDERMS) to coordinate the operation of a large number of DERs. In normal grid operations, the system would aggregate multiple DERs consisting of flexible loads, renewable resources, and energy storage systems. The DERs would be coordinated to optimize power flow and respond to a distribution system operator electricity market. In an emergency situation, the system would provide any needed reactive power support to the distribution grid with smart inverters. Additionally, the system would coordinate DERs on the distribution system to help restore the grid in the event of an outage.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The project will develop controls to create virtual generators by aggregating DERs. The aggregated virtual generators would be capable of providing energy shifting, frequency regulation, and flexible ramping services to mitigate the uncertainties brought by renewable generation. The iDERMS has the potential to increase renewable penetration, reduce GHG emissions and make virtual generators cost competitive with centralized power plants.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1g, 3a, 3f, 5a

Lower Costs:

The project team estimated that the iDERMS will yield annual electricity savings of 4,840 GWh, distribution system peak reduction of 450 MW, and quantifiable electricity cost reduction of $360 million per year in California.

Environmental Benefits:

The project team estimated this project will yield annual greenhouse gas emission reduction of 2.2 million metric tons in California by more efficient use of DERs.

Public Health:

As virtual aggregation of DER increases, the DER can be coordinated to provide functions of fossil fuel power plants, which will result in lower emissions and cleaner air. This will lead to improvement in health for California residents.

Assignment to Value Chain: Distribution		**Total Budgeted Project Admin and Overhead Costs:** $77,873	
EPIC Funds Encumbered: $1,119,437		**EPIC Funds Spent:** $346,348	
Match Partner and Funding Split: PetaPower, Inc.: $149,524 (9.1 %) University of California, Riverside: $380,868 (23.1 %)		**Match Funding:** $530,392	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 23 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-090 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: No issues. Just had a successful technical briefing from team on the last of the three software modules. The project is on time and on budget. The team met with SoCal Edison's distribution system operator group on August 27, 2018 in Rosemead. The Edison group has shown interest in using the final product.

APPENDIX B:
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Project Name:

Energy Efficiency and Water Savings in Agriculture by Innovative Plant-Aware Irrigation System

[EPC-15-091]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 12/30/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Current irrigation practices for California fruit crops, is to water according to a weekly schedule with a fixed quantity of water each time, or based on climate conditions, regardless of the actual water needs of the plants. This method results in over-irrigation and is often detrimental to the quality of the fruit or its yield.

Project Description:

This project addresses the specific problem of fixed watering schedules for agricultural crops by demonstrating a new irrigation system that saves both water and energy. This system performs on the principle that crops are watered only when needed, and not just on a set time-interval. The additional benefits of this system are the improved quality and yield of the crop. The goals of this project are to demonstrate the Plant Aware Irrigation (PAI) system on perennial crops, quantify the energy and water savings, and engage customers' feedback of perceived benefits while acknowledging their concerns. The technology is being demonstrated in three vineyards.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The technology being demonstrated precisely detects when crops need water, triggering irrigation only when needed. Delivering less water reduces pumping and the associate energy use, lowering GHG emissions. Expanded deployment to other California perennial fruit crops has the potential to save significant amounts of energy and water, moving the state closer to its energy goals.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 3g, 4a, 4c

Lower Costs:

The project could lower costs to growers through reduced water consumption and reduced energy consumption from pumping well water. An estimate of 30 percent water savings per farm on average would lead to statewide water savings of about 500,000 acre-feet per year (or 160 billion gallons per year). This corresponds to about 220 million kilowatt hours of electricity savings, most of which will happen between the months of May and September, the period of greatest stress on the electricity grid.

Environmental Benefits:

The project achieves environmental benefits through reduced water consumption. Water is currently wasted by watering crops on a regular schedule while this technology will save water by watering based on plant needs. Reduction in water use cuts down the need for water pumping and associated energy use, thus reducing greenhouse gas emissions.

Consumer Appeal:

Limiting water to wine grapes could produce higher quality grapes as measured by earlier berry ripening, improved sugar per berry and individual berry weight, resulting in higher grade wines.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $307,688	
EPIC Funds Encumbered: $1,097,990		**EPIC Funds Spent:** $146,675	
Match Partner and Funding Split: Fruition Sciences: $331,000 (23.2 %)		**Match Funding:** $331,000	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 27 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 4

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-091 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Sap sensors were installed at vineyards and measurement data was collected. The project was delayed due to wild fires and site changes. This affected some of the data collection but should not affect the final report. The sensors were removed for grape harvest season and watering is typically discontinued from December through June. The recipient is evaluating the data, starting the final report outline, and conducting technology transfer activities, such as disseminating information to the Almond Board and the utilities. The draft final report is anticipated in May 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal

[EPC-15-092]

Recipient/Contractor:

Tomorrow Water dba BKT United

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Many of California's groundwater aquifers are unused for drinking water due to contamination by nitrate and/or perchlorate. Existing groundwater treatment methods generate a concentrated brine stream that requires disposal measures rendering it unsuitable for inland sites. Existing biological treatment alternatives do not generate a brine stream but are very energy intensive. A cost effective, low energy treatment option for contaminated ground water resources is needed for inland communities in Central and Southern California to increase water supply.

Project Description:

The project is demonstrating a biofiltration system that uses 15-20 percent less energy when compared to conventional technology used to treat contaminated water to meet drinking water standards or for use in industrial and/or agricultural applications. The technology is being demonstrated in the City of Barstow and the focus is removal of nitrate, perchlorate and turbidity from the wastewater. The project includes water testing to secure Conditional Acceptance as a Title 22 drinking water treatment technology from the State Water Resources Control Board.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project is anticipated to offer a lower energy alternative for treatment of the most common contaminants preventing use of ground water resources in California. The project could enable the development of new water supplies in many of the drought challenged regions of the State. Local treatment of impaired groundwater will provide additional energy benefits by eliminating the cost associated with transporting clean water from distant sources. The biofiltration treatment technology has the potential of efficiently treating contaminated water in an energy efficient manner while generating no waste brine.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 4a, 4d

Lower Costs:

The biofiltration system in this project yields cost savings through reduced energy use because the media used in the system is backwashed by gravity rather than pumping. Additionally, recirculation pumping, common in other biofiltration systems that use activated carbon, requires regular interval replacement. The BKT biofiltration technology uses a floating media and does not require regular replacement. The recipient estimates a 70 percent reduction in electricity costs and a 20 percent reduction in operating costs compared to typical up-flow treatment systems.

Environmental Benefits:

This low energy system treats contaminated water so that it can be used as drinking water supply. This can provide a source of local drinking water and eliminates the need to transport clean water from distant sources. The system also does not generate brine which is a byproduct waste which typically require landfill disposal.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $1,722,072	**EPIC Funds Spent:** $1,302,662
Match Partner and Funding Split: Kana Engineering Group, Inc.: $100,000 (4.7 %) City of Barstow: $75,000 (3.5 %) Khalil Kairouz Consulting: $5,000 (0.2 %) Eurofins Eaton Analytical: $49,860 (2.3 %) Tomorrow Water dba BKT United: $172,637 (8.1 %) MWH: $15,000 (0.7 %)	**Match Funding:** $417,497
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 35 bidders	Group 2: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-092 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The Recipient finished the acclimation process to introduce microorganisms for colonization of the bioreactor. The biofiltration system is operating in continuous mode; it was previously running in batch mode as the Regional Water Board had concerns over the perchlorate concentration. The Recipient is now focusing on determining the minimum contact time of water to treatment medium required to achieve nitrate and perchlorate removal below CA's Maximum Contaminant Levels and optimizing the chemical injection system to determine minimum acetic acid concentration. Electricity data will be collected at the main submeter for the biofiltration system and compared to the baseline to calculate savings.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Accelerating Drought Resilience Through Innovative Technologies

[EPC-15-093]

Recipient/Contractor:

Water Energy Innovations, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/13/2016 to 10/31/2018

Program Area and Strategic Objective:

Market Facilitation

S20: Accelerate the Deployment of Energy Technologies in IOU Territories Through Innovative Local Planning and Permitting Approaches.

Issue:

California's historic drought has been especially severe in the San Joaquin Valley and rural communities have been significantly affected. Immediate solutions are needed to support the communities. Unfortunately, traditional water infrastructure solutions are expensive, often energy intensive, and have long lead times for implementation which makes it difficult to quickly identify and finance the best technologies that save water and energy for a specific project site.

Project Description:

This project compiled data from county utilities to find what industries had the highest energy impact during the drought. Then, the project provided input on what water-energy technologies would lessen the impact during future droughts. Finally, the team assisted local jurisdictions in implementing strategies and measures that reduce development times and costs, as well as recommended innovative financing mechanisms and cutting edge water-energy technologies. The recipient piloted the model for Tulare County in an effort to develop a roadmap for implementation of the model in other similar rural agricultural communities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will develop a comprehensive regional drought resilience plan that will match high potential energy and water efficiency technologies with potential adopters. This will lead to greater reliability and drought resiliency while reducing agricultural energy demand.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Applicable Metrics: CPUC Metrics- 3e, 4c

Lower Costs:

The project is helping to lower costs by streamlining the deployment of drought resilient technologies that reduce the amount of electricity needed to collect, transport, treat and deliver water to end use customers.

Greater Reliability:

The project is developing a replicable model that matches advanced water and electricity technologies with high priority projects in California's rural agricultural communities. The model integrates streamlined permitting and approval processes and finance mechanisms, enabling the adoption of innovative technologies that increase water and electricity reliability.

Consumer Appeal:

The project is creating strategies, toolkits and technology portfolios that will be easily transferrable to entities in rural and agricultural communities. This project is also assessing agricultural, residential and non-residential market and customer barriers to adopting advanced water and energy technologies.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $178,824	
EPIC Funds Encumbered: $1,000,000		**EPIC Funds Spent:** $999,376	
Match Partner and Funding Split: Syzergy, Inc.: $5,000 (0.5 %)		**Match Funding:** $5,000	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 27 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-093 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project completed in October 2018. The project identified specific technology solutions and strategies that Tulare County and similar communities can use to build drought resilience while also supporting electric reliability and reducing greenhouse gas emissions. A model Drought Resilient Technologies Program, developed by the project, is embodied in the Drought Resilient Toolkit (http://droughtresilience.com/). This project found that most drought resilient opportunities involve actions and investments by water users, and that significant draught resilient in Tulare County could be achieved by implementing just the following solutions: convert flood to drip irrigation, recycle/reuse food processing water, and accelerate change outs to water efficient fixtures.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities

[EPC-15-094]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan 2015-2017 Triennial Investment Plan	6/15/2016 to 3/30/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development
S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

California's zero net energy and global climate change goals will require a huge increase in building and end-use system efficiency. The immediate goal of all new homes to be zero net energy by 2020 will require a better understanding of cost effectiveness, technical feasibility and operational performance. Large scale field demonstrations that show integrated technology pathways in multiple climate zones are needed to demonstrate cost effectiveness, monitor and verify energy and cost savings and other benefits, and evaluate new technology and integration strategies, such as community solar and impacts on the distribution grid.

Project Description:

This project is demonstrating cost-competitive ZNE design strategies that combine occupant needs with technology solutions to create new pathways for residential ZNE communities. The strategies will be demonstrated in single and multifamily buildings. The project's goals are cost effectiveness for the customer, affordability, overcoming customer apprehension, establishing a track record of new technology for builders, enabling distribution grid integration, creating a planning process for ZNE communities, evaluating community solar and evaluating the impact of future changes to ZNE cost effectiveness. This project also aims to understand the operation and energy use of the unregulated loads.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This research will provide new methodologies for integrating occupant and technology needs into a cost effective and scalable zero net energy (ZNE) strategy. The project will analyze and define the savings and market barriers in residential communities and provide new,

valuable performance data and models from the demonstrations. The products from this research will be essential to identifying the successes and barriers to meeting the ZNE goals for residential communities.

CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)
Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 2a, 4a

Lower Costs:

Zero net energy (ZNE) homes could result in significant savings in money, resources, operation and maintenance, energy, and greenhouse gas emissions. Both ratepayers and customers benefit from implementing ZNE residential communities. The estimated cost savings related to the energy savings is $1,242/home/year. Over a 50-year life of a ZNE home, this would translate to a net present value of nearly $80,000 in realized value for the homeowners.

Environmental Benefits:

The recipient estimates that a ZNE home in California will annually reduce electric and gas use by 7000 kWh and 200 therms, respectively (Climate Zone 10). Assuming 80,000 new single and multifamily new homes in California annually, the potential annual savings in energy use translates to up to 560 GWh and 16 million therms. This is estimated to reduce greenhouse gas emissions per home by 6456 lbs. annually (or 3.041 metric tons). If all new homes were ZNE, this would result in an annual reduction of 24,000 metric tons of GHG emissions.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$1,460,838
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$4,942,809	$469,224
Match Partner and Funding Split:	**Match Funding:**
Electric Power Research Institute, Inc.: $676,007 (11.2 %) Fresno Housing Authority: $200,000 (3.3 %) LINC Housing Corporation: $233,475 (3.9 %)	$1,109,482

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 6: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-15-094 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
All project demonstration sites were changed due to prevailing wage issues and a one year time extension was approved to allow time for the required M&V after occupancy. The four sites include construction of new single family homes in Belmont, and multifamily units in Compton, Fresno and Pomona. The research team is currently investigating potential upgrades for battery technologies, performance walls, lighting, and water heating technologies. The buildings are expected to complete construction in 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstrating Innovative Leakage Reduction Strategies: Correlating Continuous Acoustic Monitoring, Satellite Imagery and Flow Sensitive Pressure Reducing Valve System

[EPC-15-096]

Recipient/Contractor:

American Water Works Company, Inc.

Investment Plan:	**Project Term:**
2012-2014 Triennial Investment Plan	6/30/2016 to 3/30/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Water utilities across the country struggle with aging pipe infrastructure, resulting in water loss from leaks. The loss of water in the water distribution lines means energy is being wasted because to produce potable water for delivery to customers requires substantial energy associated with treatment and conveyance--or the embedded energy in water. The longer the leak goes unidentified, the already treated water in the pipeline is wasted, along with all the energy used to produce and convey that water. Underground water leaks are difficult to detect and manage.

Project Description:

This project is demonstrating three leak detection technologies to reduce the amount of water lost from leaks and the amount of embedded energy wasted due to these leaks. The technologies tested include satellite imagery leak detection, correlating continuous acoustic monitoring, and flow sensitive pressure reducing valves. These technologies have site demonstrations in four Southern California cities. The Recipient will present achievable and measurable water savings in water distribution systems and show the potential for water and energy savings. An economic analysis of the costs and benefits of the technologies will be developed to assist in considering solutions for water loss reduction and energy efficiency. The project benefits will be quantified through water saved, embedded energy saved and associated greenhouse gas emissions reduced.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will advance the technical knowledge of detecting and preventing underground water leaks and estimating the energy savings associated with the water leak detection/prevention strategies. Identifying and demonstrating tools to help water agencies

monitor, assess and manage their water distribution systems conserves water resources, increases water system reliability, lower emergency and repair costs and reduces water and electricity costs for ratepayers. These benefits will be quantified through the volume of water saved and the embedded energy in the saved water.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 4c

Environmental Benefits:

The technologies demonstrated in this research project could provide information to water agencies on leaks in their system and to take action to repair leaky systems to save water. Water loss due to leaks impacts overall energy use due to the embedded energy associated with treating and transporting water that is no longer available due to leakage.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $222,664
EPIC Funds Encumbered: $1,517,780	**EPIC Funds Spent:** $1,106,278
Match Partner and Funding Split: American Water Works Company, Inc.: $311,641 (16.3 %) Hazen & Sawyer: $3,000 (0.2 %) Echologics: $76,820 (4.0 %)	**Match Funding:** $391,461
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 35 bidders	Group 2: Ranked # 7

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-15-096 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: At the City of Duarte test site, Utilis (the Satellite Imagery subcontractor) and Echologics have begun operations in detecting leaks and repairing them. At the City of Ventura site, flow monitors are being installed in various locations for baseline monitoring. At the City of Coronado site, the project team is monitoring the site for leaks with the flow sensitive pressure reducing valves. Monitoring at each site will occur for a period of 12 months.

APPENDIX B:
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Project Name:

Achieving Zero Net Energy in Multi-Family Buildings

[EPC-15-097]

Recipient/Contractor:

Build It Green

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/1/2016 to 3/30/2021

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

There is a critical need for more research and evaluation of zero net energy multifamily design and construction approaches and practices. Many key design issues remain poorly understood in the multifamily sector, particularly for emerging all-electric heating, ventilating and air conditioning and domestic hot water technologies. These include the performance and economic trade-offs of technology solutions, lack of agreement between design and actual performance for key emerging technologies, and a lack of understanding of how these technologies will impact tenants and property managers.

Project Description:

This project demonstrates the potential of breakthrough electric water heating and space conditioning technologies as a pathway to zero net energy. The project explores the complex, interdependent systems in multifamily buildings and how they work together to achieve zero net energy status for the buildings in a cost-effective manner. Four multifamily buildings, designed to be affordable, are to be evaluated in various stages of design and development. These buildings share a goal of all electric zero net energy construction with 100 percent renewable energy generation, and utilize innovative new heat pump technologies to serve the buildings water heating and/or space conditioning needs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project demonstrates the technical and economic feasibility of zero net energy design for large multifamily projects and establishes design and installation best practices that minimize risks for developers. This includes documentation of best practices to ensure that energy and cost benefits of zero net energy are fully realized and identified, including the trade-offs between technology solutions, capital costs, operating and maintenance costs, environmental benefits and grid impacts.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h
Lower Costs:
This project helps developers make more informed zero net energy design decisions which may reduce construction costs for multifamily buildings up to $2,000 per apartment and lower future operating (e.g., energy) costs for building owners and occupants.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$0</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,955,811</td><td colspan="2">EPIC Funds Spent:
$931,714</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Resources for Community Development: $45,090 (2.0 %)
Corporation for Better Housing: $245,000 (10.9 %)</td><td colspan="2">Match Funding:
$290,090</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 2</td></tr>
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<tr><td colspan="4">Treatment of Intellectual Property:
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Product name: Confidential Utility Consumption Data
Patented equipment. High temperature heat storage itself is not a novel or patented concept by GE, but new controls (e.g. software and firmware) and the existing Geospring heat pump are proprietary.</td></tr>
</table>

APPENDIX B:
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Update:

This project is on track. The construction of all four multifamily buildings in Sunnyvale, Atascadero, Cloverdale and Calistoga is now complete. The installation of domestic hot water monitoring devices such as meters, data loggers and sensors were completed for all buildings in 2018. Energy display installations, which uses colors to inform occupants in real time how much energy is being consumed, will be completed in all sites by March 2019. In 2019, all data collected on DWH, thermal storage, HVAC, systems performance, electrical consumption, occupancy behavior will be analyzed to determine technical and cost effectiveness and how close each building is achieving Zero Net Energy status. The monitoring period will be completed in May of 2020.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Measure Results from Affordable Zero Net Energy Homes [EPC-16-001]	
Recipient/Contractor: Institute of Gas Technology dba Gas Technology Institute	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 7/30/2016 to 3/31/2021
Program Area and Strategic Objective: Applied Research and Development S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.	
Issue: The California Energy Efficiency Strategic Plan includes four Big Bold Initiatives, one of which states that all new residential construction in California will be zero net energy by 2020. To help achieve this goal, demonstrated proof in the form of measured field performance of new and emerging technologies is needed to help overcome skepticism about the magnitude of the Plan's energy savings potential and cost-effectiveness.	
Project Description: The project implements lessons learned from previous high performance housing research and measures the results in two new homes being built in partnership with Habitat for Humanity in a disadvantaged community in Stockton. Both houses include advanced architectural design features, high performance enclosures, advanced heating, ventilating and air conditioning systems, and low-cost water heating systems. One all-electric home and one mixed fuel (combined electric and natural gas) home is being built to demonstrate the respective cost-effectiveness of each set of features. In addition to measuring actual performance of occupied houses, the project is developing a guide to affordable residential zero net energy design and construction along with a training curriculum, and will offer training opportunities based on the project results.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The technological advancement in this project is to utilize innovative construction approaches that couple advanced energy efficiency measures with integrated project design and delivery (IPD) in a cost-effective manner. These approaches aim to reduce structural framing to minimize heat paths through the walls, improve wall and attic insulation, increase equipment	

<table>
<tr><td colspan="4">efficiency, reduce air infiltration levels, and improve water heater and HVAC performance. The approaches will emphasize minimum energy use, high indoor air quality, robust and appealing architectural design, solid structural integrity, and practical, low cost construction. If successful, these innovative approaches could become standard construction practice leading to widespread deployment of affordable ZNE homes.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a
Lower Costs:
The advanced integrated energy efficiency packages included in this project could reduce annual energy costs for homeowners by up to 50 percent.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$325,815</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,000,000</td><td colspan="2">EPIC Funds Spent:
$281,319</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Dettson: $8,500 (0.7 %)
Southern California Gas Company: $160,000 (13.7 %)</td><td colspan="2">Match Funding:
$168,500</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
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Update:

Progress this year includes getting stakeholder feedback through technical advisory meetings to finalize pilot test design details, completing the pilot test monitoring plan deliverable, obtaining permits for the two pilot test homes, completing the mid-term benefits questionnaire, conducting outreach activities such as presenting on research efforts at the 2018 American Council for an Energy-Efficient Economy (ACEEE) Summer Study, initiating construction of the pilot homes, and developing two chapters of a book that will help educate and inform the larger builder community about affordable ZNE design. Habitat for Humanity has hired additional staff to expedite construction efforts in 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Pathways to More Cost-Effective ZNE Homes

[EPC-16-002]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	9/1/2016 to 6/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

The State of California has set the goal for all new residential construction be Zero Net Energy (ZNE) starting in 2020. This is a dramatic increase in volume, going from ~40 units in 2014 to >150,000 units in 2020. To date, there are no comprehensive studies on the cost-effectiveness of ZNE homes, the dependence of cost-effectiveness on building type (single family versus multifamily; all-electric versus non all-electric) and geographical location, and the impact of high volume production of ZNE components. This project will address these deficiencies to help inform policymakers on the best methods for cost-effective implementation of ZNE homes.

Project Description:

This study provides detailed cost-effectiveness modeling of all electric, Zero Net Energy (ZNE) homes compared to mixed-fuel ZNE homes with gas-based heating. Evaluation includes costs of building integration, energy efficiency packages, installed equipment, and lifetime investment costs. The project provides spatial and temporal analyses to enable an assessment of cost-effectiveness in four California climate zones. This information will help policy makers better understand the cost and benefit tradeoffs of ZNE policy - and allow for more informed planning to reach ZNE targets in 2020 and 2030. It will also provide the information on the climate trade-offs of all electric homes compared to those with electric and gas service.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project identifies key cost-reduction opportunities to inform future policy decisions and includes development of cost data on photovoltaic cost reduction potential, building shell measures, and future end-use appliance costs and performance and estimates of cost sensitivities of various ZNE related issues. The latter includes offsite renewable energy

procurement, climate impacts, and policy levers, such as mortgage tax credits and incentives.
CPUC Proceedings addressing issues related to this EPIC project: Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]
Applicable Metrics: CPUC Metrics- 1f, 1h, 4a Lower Costs: When project recommendations are implemented by builders, it could result in reduced construction costs for builders and operating costs for homeowners. This will result in a lower cost ZNE home due to economies of scale in manufacturing and lower energy bills for the occupant. Greater Reliability: When project recommendations are implemented by builders, it could result in increased grid reliability by reducing demand side load and increasing adoption of distributed energy resources. Environmental Benefits: This project could reduce greenhouse gas (GHG) emissions by providing the building industry with the most cost-effective approaches toward implementing renewable energy and energy efficiency measures into community development projects. When project recommendations are implemented by builders, it could result in offset of end-use demand and avoided capacity needed at the generation level and potential reduction of GHG emissions associated with that demand.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $436,541
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $1,000,000
Match Partner and Funding Split: Lawrence Berkeley National Laboratory: $50,000 (4.8 %)	**Match Funding:** $50,000

APPENDIX B:
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<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project is currently ahead of schedule. The team has briefed the Energy Commission staff on some of its results, and continues to finalize some modeling scenarios with feedback provided during those meetings. Preliminary results identified cost-effective approaches to ZNE construction for both mixed-fuel and all-electric homes. Staff will work on the final report in early 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Pilot-Scale Evaluation of an Integrated Building Control Retrofit Package [EPC-16-003]	
Recipient/Contractor: Regents of the University of California, Davis	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 7/18/2016 to 12/31/2020
Program Area and Strategic Objective: Applied Research and Development S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.	
Issue: The traditional approach to building automation consists of a collection of independent control systems, one for each building end use, with limited or no communication among the individual devices. Several research efforts during the past decade were aimed at improving electric lighting or fenestration control methods, increase system reliability and reduce lighting energy use. However, few efforts accounted for the interdependence of lighting, fenestration and space conditioning systems and the consideration of the latter in an integrated approach to optimize whole building energy efficiency via a single, unified control platform.	
Project Description: This project tests an integrated building control package that maximizes energy efficiency for existing commercial buildings. The project refines novel control algorithms that utilize shared device state and environmental data for lighting, fenestration and heating, ventilating and air conditioning (HVAC) systems. Sharing data from multiple device types will further improve overall, sustained, system performance and operation. Control algorithms prioritize lighting or heating/cooling savings based on climate and building design. HVAC system management leverages passive ventilation through windows and skylights and dynamic adjustment of HVAC set point dead bands.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project seeks to improve sensor-controlled lighting and air conditioning systems by integrating and sharing information from multiple sensors, resulting in better quality indoor spaces with reduced energy cost. This research will focus on refinement and testing of an Integrated Building Control Retrofit Package. The includes the refinement of novel control algorithms that utilize shared device state and environmental data among lighting, fenestration and HVAC devices.	

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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 3e

Lower Costs:

Avoided costs of the retrofit package deployed in 2% of the existing commercial office floor space totals $90 million over a ten-year period.

Consumer Appeal:

This project will develop systems which improve the functionality of lighting and heating, ventilating and air conditioning controls, and integrate operations with automated shading, natural ventilation, and air conditioning systems, to create more appealing and comfortable indoor environments.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $392,705
EPIC Funds Encumbered: $1,999,089	**EPIC Funds Spent:** $517,298
Match Partner and Funding Split: Regents of the University of California, Davis - California Lighting Technology Center: $263,967 (11.7 %)	**Match Funding:** $263,927
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 39 out of 39 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The testing site for this project was switched from the Rifle Range to the Barn, both office type buildings on the campus of UC Davis. In 2019, the team will install the integrated control system at the site to test real operating conditions. Currently, the team is testing the system.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Integrated Whole-Building Zero Net Energy Retrofits for Small Commercial Offices

[EPC-16-004]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/30/2016 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Small commercial offices in California consume about 3,500 GWh of electricity annually. This usage is projected to increase due to increasing use of office electronics and decarbonization- driven fuel-switching of space and water heating systems. As a result, the need for deep reductions in electricity usage is needed. However, this sector faces a number of barriers to achieving these energy reductions, including lack of awareness on how to achieve energy targets and integrated solutions, and affordable access to energy reduction services such as engineering and auditing services. Energy efficiency tools and services currently involve high costs on a per-square-foot or kWh-saved basis.

Project Description:

This project develops and evaluates cost-effective packages of pre-commercial integrated energy efficiency measures and controls to achieve zero net energy (ZNE) performance for small commercial offices in California. The project team is utilizing Lawrence Berkeley National Laboratory's FLEXLAB to test whole-building integrated systems under varied climate and use conditions, with additional testing to be conducted at a retrofitted office building in Berkeley, CA. The team is aiming to achieve a minimum of 50 percent energy savings over baseline conditions at the retrofit site to achieve ZNE. Data on energy, occupant comfort, and occupant behavior are being analyzed to identify best practices that can be replicated elsewhere in the State.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project develops and validates integrated whole building retrofit packages using pre-commercial underutilized technologies and controls with the goal of reducing energy use in small commercial offices by at least 50 percent. The project also aims to increase system reliability by reducing peak energy loads and potentially supporting automated demand

response implementation. The energy efficiency and demand reduction components of the project provide a path towards meeting the State's energy efficiency and climate goals along with a means to replicate these strategies.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a, 4a

Lower Costs:

The project aims to reduce energy use by at least 50% in small commercial offices.

Environmental Benefits:

Assuming 5 percent of small commercial buildings (less than 30,000 square feet) in California adopt the proposed retrofit measures (including on-site renewable energy generation) by 2030, greenhouse gas emissions could be reduced by 83,238 metric tons per year.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $706,115	
EPIC Funds Encumbered: $2,000,000		**EPIC Funds Spent:** $1,560,556	
Match Partner and Funding Split: Northern California test site partner: $2,000,000 (50.0 %)		**Match Funding:** $2,000,000	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 39 out of 39 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Progress this year includes ZNE package development, initiating and completing FLEXLAB testing, finalizing ZNE retrofit site design and measurement plan, and getting stakeholder feedback through technical advisory committee meetings. LBNL is working closely with the City of Berkeley to complete the office building retrofit to achieve ZNE with construction scheduled to be completed in 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Energy Efficient HVAC Packages for Existing Residential Buildings

[EPC-16-005]

Recipient/Contractor:

Regents of the University of California, Davis

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	8/1/2016 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

To meet California's long term energy efficiency plan, existing buildings must be retrofitted for energy efficiency to bring them on par or exceed current California efficiency building standards. Specifically, cooling of single-family homes will account for more than 5,700 GWh annually by 2024. While several new heating, cooling and ventilation (HVAC) technologies exist for improving energy efficiency, research and development is needed to create cost-effective retrofit packages for existing buildings, and to identify opportunities to encourage widespread adoption of these packages.

Project Description:

This project demonstrates innovative pre-commercial, cost-effective retrofit packages for cooling and ventilation for single family homes. Energy savings, occupant behavior and indoor air quality (IAQ) are to be measured for two specific retrofit packages that each includes three innovative technologies: (1) building envelope sealing, (2) two variants of smart mechanical ventilation that include pre-cooling strategies, and (3) mostly compressor-free evaporative air-conditioning. Furthermore, barriers and opportunities towards adoption of such retrofits are to be identified through stakeholder interviews.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

To address the current issues with indoor air quality and energy efficiency in existing homes, this project will demonstrate and evaluate two residential retrofit packages that incorporate advanced technologies for achieving both of these goals. Better envelope tightness combined with a dedicated ventilation system and highly efficient evaporative cooler will increase indoor air quality, reduce energy use for air conditioning and reduce overall peak demand. Additionally, the project could increase comfort for building occupants and reduce energy costs for building owners.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 2a

Lower Costs:

This retrofit package could reduce HVAC energy costs in existing buildings by over 50 percent through the use of compressor-less cooling technology. The project also hopes to identify opportunities to encourage widespread adoption of these packages by promoting to utilities and builders, thus potentially reducing deployment costs.

Environmental Benefits:

The demonstration packages could reduce energy consumption and thus reduce greenhouse gas emissions, especially during peak demand hours. The energy savings is estimated to reduce greenhouse gas emissions by 56,000 metric tons per year by 2024. Also the evaporative cooling system provides an alternative to vapor compression cooling that reduces the usage of refrigerants are known to contribute to global warming.

Consumer Appeal:

The increased indoor air quality from a system that actively brings in filtered, fresh air will improve comfort and occupant health over a typical system that relies on uncontrolled building leakage to provide outdoor air.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $366,421
EPIC Funds Encumbered: $1,200,000	**EPIC Funds Spent:** $180,715
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: Western Cooling Efficiency Center - UC Davis: $126,000	**Leveraged Funds:** $126,000

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	39 out of 39 bidders	Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

One year of baseline monitoring has been completed and currently awaiting the installation of the Smart Vent and Night Breeze systems along with the sub wet bulb evaporative cooling (SWEC) and DX coil. Two similar but unique retrofit packages will be installed starting in December 2018. Once installed then post monitoring will start in early June 2019. Both sites will receive aerosol envelope sealing, and a sub wet bulb indirect evaporative cooling (IDEC) with a fresh air vent system. A small add-on direct expansion coil will be added to each IDEC unit to allow for extra cooling during limited high summer temperatures. Indoor air quality is also being measured and will monitor CO2 and PM2.5.

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Project Name:

Low Energy, Zero Liquid Discharge Adsorption Technology to Remove Contaminants and Recover Source Water

[EPC-16-006]

Recipient/Contractor:

ES Engineering Services, LLC

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/28/2016 to 3/23/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

In California, many groundwater sources cannot be used for drinking water because of arsenic, chromium and other contaminants. Current technologies to treat contaminated drinking water are expensive, complex, and energy intensive, such as reverse osmosis. Other factors driving costs higher for conventional treatment include the need for expensive chemicals, daily management of high volume of waste laden with contaminants, and active process control, monitoring and adjustment. An alternative treatment system is needed that can effectively remove heavy metal contaminants from water, minimize energy, operation and waste disposal costs and meet California drinking water standards.

Project Description:

The project is testing an innovative, low energy, zero liquid discharge water treatment system using adsorption process to potentially remove arsenic and other contaminants from a groundwater reservoir. The project is developing a demonstration-scale water treatment system to determine operational costs, energy and water savings of the single use adsorption system The demonstration will validate the reduction in spent adsorption media by natural dehydration to further save energy and water associated with residual solid waste handling. The project includes testing and reporting to secure state mandated acceptance of the novel drinking water treatment technology.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project could result in an innovative way to treat water with high amounts of metal contaminants using a low energy treatment method to restore impaired drinking water sources. The hydrogel adsorption process offers benefits of being simple, with its minimal amount of equipment required and can save water that would normally be too difficult to treat.

This treatment method is especially suitable for small inland treatment systems, where liquid backwash and brine disposal may be cost prohibitive or infeasible.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1h, 4c, 4d

Lower Costs:

This project could lower the cost of treating water contaminated with heavy metals and allowing it to be reused. The energy reduction compared to conventional technologies is 20-30 percent when applying this new, low energy technology.

Environmental Benefits:

Resurrecting groundwater wells that have been removed from operation due to contamination offers energy and cost savings by avoiding the need for additional drilling and construction of new wells. Additionally, if successful, this project can improve water resources by removing heavy metal contaminants from water.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $986,262	**EPIC Funds Spent:** $317,540
Match Partner and Funding Split: Enova Water LLC: $65,000 (5.5 %) AQUAlity Engineering, Inc.: $15,474 (1.3 %) Khalil Kairouz Consulting: $4,000 (0.3 %) Municipal Management Group, Inc.: $5,000 (0.4 %) ES Engineering Services, LLC: $105,430 (8.9 %)	**Match Funding:** $194,904
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 35 bidders	Group 1: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Enova has pre-existing intellectual property that is relevant to the project. The intellectual property is the single use adsorption media for metals, and is currently patented.

Update:

The recipient completed installation of the system at the City of Cerritos and has begun the measurement and verification phase. The project term was extended due to various issues hindering flow rate and initial contaminant levels.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Optimization of Energy Efficiency to Achieve Zero-Net Energy in Multifamily and Commercial Buildings

[EPC-16-007]

Recipient/Contractor:

Regents of the University of California, Davis

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	8/1/2016 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

The technical feasibility of achieving Zero Net Energy (ZNE) in many building types in California has been documented, but the optimal cost-effective strategy to reduce net electricity consumption toward ZNE goals remains unclear. The number of building types and technologies are too numerous to answer performance and cost-effectiveness questions through field studies. The open-source software tools and analysis methodologies are difficult to monetize and would require coordination among competitors, and are not being developed nor funded by competitive markets.

Project Description:

This is a modeling study. The recipient uses EnergyPlus, a building energy modeling tool, to analyze the cost-effectiveness of various electricity saving/generation measures for multifamily and commercial buildings in California. Each building type and climate zone will receive a cost-benefit analysis for each measure individually and an optimized package of measures to achieve as close to zero net energy as is cost-effectively possible.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will accelerate the adoption of cost-effective electricity saving and generation technologies, equipment, materials and construction practices in California multifamily and commercial buildings.

By developing new methods and expanding on existing modeling methods using OpenStudio, a building energy modeling software developed by the Department of Energy, this project aims to enable rapid evaluation of energy efficiency packages to determine the

<table>
<tr><td colspan="4">most cost-effective approaches to achieve zero net energy buildings.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h, 3e
Lower Costs:
This project could influence construction practices in California and promote the development of affordable energy efficiency in commercial and multifamily buildings. This project will provide optimized recommendations for cost-effective electricity saving solutions for a wide variety of California's building portfolio in all 16 climate zones. Detailed modeling of building energy modeling packages will allow for accurate determination of cooling and heating loads, enabling right sizing of equipment which could extend equipment life for building owners. Equipment right sizing would provide lower costs due to smaller equipment sizes and potential for lower maintenance costs.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$151,821</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,000,000</td><td colspan="2">EPIC Funds Spent:
$274,714</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Electric Power Research Institute, Inc.: $25,000 (2.3 %)
Regents of the University of California, Davis: $80,000 (7.2 %)</td><td colspan="2">Match Funding:
$105,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The recipient continues to refine performance parameters for high efficiency measures. Work has begun on testing the OpenStudio Parametric Analysis software to perform the large set of permutations required to provide a zero net energy optimization package. Work is ongoing to implement and test a method for automated optimized sizing of HVAC equipment in the toolset.

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Project Name: Santa Monica Advanced Energy District [EPC-16-008]	
Recipient/Contractor: City of Santa Monica	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 9/15/2016 to 12/31/2018
Program Area and Strategic Objective: Market Facilitation S20: Accelerate the Deployment of Energy Technologies in IOU Territories Through Innovative Local Planning and Permitting Approaches.	
Issue: While many local governments could benefit from a multiuser microgrid, few are poised to take advantage of such district-scale energy systems as they lack the 1) technical knowledge of how to interconnect a suite of different energy resources with storage and control technologies, 2) regulatory frameworks that allow for multiple interconnection points by different customers at different locations, and 3) means to incentivize the private sector to deploy these systems to serve more than one end-user. Finally, ownership and fee structures that benefit the participants of multiuser microgrids are extremely complicated and the role of local governments is still being developed.	
Project Description: The city of Santa Monica designed an advanced energy district with a multiuser microgrid that is anchored at the City Yards, an old landfill site where most of the city's municipal buildings and fleets are housed. The design integrates a suite of local renewable energy sources, energy storage, and controllable loads into a single system that can be scaled to interconnect adjacent, public and private properties inclusive of the Bergamont Art District and Metro Maintenance Facility. The project team explored what role the city can play in delivering and wheeling power between customers, and what special utility tariffs and financing can help incentivize a system that shares the value of distributed energy resources equitably. Next, the project team developed a financial and ownership model for constructing and operating a multiuser microgrid that achieves a net-zero, or near net-zero energy district for the customers. A case study and tool kit of outreach materials was developed to share with stakeholders and other local governments.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments must play a role in achieving the goal by operationalizing community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project pilots innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3b, 3e

Lower Costs:

This project provided a streamlined approach to reduce the time and costs needed to bring community-scale IDER projects to a shovel-ready state.

Greater Reliability:

The tools and resources developed under this project assisted in identifying citywide optimal microgrid sites that will have the most local generation potential and are most likely to have the least impact on grid reliability.

Economic Development:

This project piloted new approaches that increase the financial attractiveness of community-scale IDER projects, which could lead to increased investment in the community.

Energy Security:

Microgrids using renewable energy generation, coupled with storage systems, allows critical facilities to generate their own energy locally and be cost competitive to the grid. These systems also reduce transmission losses.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$570,347
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,487,609	$48,440

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:
City of Santa Monica: $217,460 (12.5 %)
Arup North America Ltd: $10,970 (0.6 %)
Hathaway Dinwiddie Construction Company: $100 (0.0 %)
Miller Hull Partnership: $23,500 (1.4 %)
Buro Happold Engineering: $1,000 (0.1 %)</td><td colspan="2">Match Funding:
$253,030</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project concluded in December 2018. After evaluating several technical and financial options, the team developed three scenarios to provide a phased approach for a low-carbon energy solution to the City of Santa Monica and surrounding community. The base-case scenario includes 1.2 MW solar PV and 7.2 MWh energy storage to meet the projected energy demand for the redeveloped City Yards, and allows for 2 days of continued operation in a power outage. The two expansion scenarios include increased solar generation and energy storage, as well as fuel cells to meet the significantly higher demands for the adjacent Bergamont Art District, and the Metro's maintenance facilities located across the street. The City will vote on a final microgrid design once the City Yards redevelopment plan is complete and financing becomes available.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Testing a Low-Energy Water Treatment System for Fail-Safe Direct Potable Reuse

[EPC-16-009]

Recipient/Contractor:

Porifera, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	8/31/2016 to 8/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Potable water demand in California will continue to grow even as droughts become more common. The main sources for new water supplies in California are importing more water over long distances, desalination, and reuse. Of these three options, reuse requires the least amount of energy. A direct potable reuse (DPR) project has not yet been permitted in California. The main hurdle is public and regulatory concern over the public health risks of implementing DPR, which some call "toilet to tap". This concern is perpetuated by the lack of real-time fail-safe methods to ensure that contaminant barriers are intact at all times and performing as designed.

Project Description:

The project is testing a low-energy, dual barrier, direct potable reuse system, known as dprShield, with breach-activated barrier technology to demonstrate that this technology can improve public health safeguards and reduce the electrical energy, chemical consumption, maintenance and overall cost for potable reuse of municipal wastewater. While being energy efficient and cost-effective, this system effectively removes trace contaminants through two tight membranes. In the event that one of the membrane barriers is breached, a Breach Activated Barrier is triggered and the contaminants are pushed away from the clean water stream, ensuring safe operation in real time. This direct potable reuse technology could replace more energy intensive processes.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will demonstrate an energy efficient solution for direct potable reuse of municipal wastewater. The dprShield is estimated to use 65 percent less energy than State Water Project transfers, 75 percent less than desalination and more than 50 percent less energy than competing technologies for direct potable reuse of municipal wastewater, removal of

contaminants from water and real-time membrane integrity monitoring.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4c, 4d

Lower Costs:

This project could provide a reliable and cost effective solution for water and wastewater treatment. This project could reduce water treatment and reuse costs, and reduce energy requirements and emissions when compared to other treatment methods.

Increase Safety:

This project can increase safety and reliability of potable water reuse projects. As potable reuse grows in California, this advancement will help overcome barriers by demonstrating an energy efficient solution for removal of contaminants from water and real time membrane integrity monitoring. This technology could detect and react to small breaches and assure pathogens do not enter the clean product water when there is a breach.

Public Health:

This project can increase safety and reliability of potable water reuse projects. As potable reuse grows in California, this advancement will help overcome barriers by demonstrating an energy efficient solution for removal of contaminants from water and real time membrane integrity monitoring. This technology could detect and react to small breaches and assure pathogens do not enter the clean product water when there is a breach.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$248,634
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$999,795	$682,969
Match Partner and Funding Split:	**Match Funding:**
Leland Stanford Junior University: $34,784 (3.0 %) City of Hayward: $10,000 (0.9 %) Orange County Water District: $70,000 (6.1 %) Porifera, Inc.: $30,000 (2.6 %)	$144,784

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
27 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Patents and trade secrets from Porifera, Inc. have been identified as relevant pre-existing intellectual property.</td></tr>
<tr><td colspan="4">Update:
The dprShield system has been installed at the Hayward and Orange County sites. Data collection is expected to be completed by May of 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Improving Water and Energy Efficiency in California's Dairy Industry

[EPC-16-010]

Recipient/Contractor:

The Regents of the University of California on behalf of the Davis campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	10/1/2016 to 9/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Milk is the most valued agricultural commodity in California. Approximately one of five dairy cows resides in California. Heat stress remains a major cause of diminished milk production and increased disease among lactating dairy cows, with annual losses directly related to heat stress exceeding $800 million. Current methods of reducing thermal stress require significant amounts of energy and water. Evaporative cooling is typically used with water sprayed on the cows using feed line soakers. These approaches require large amounts of energy to pump water and move air in sufficient quantities to reduce heat stress. The resulting hot, moist environment promotes bacterial growth.

Project Description:

This project tests and demonstrates two novel approaches to cooling livestock. With conduction cooling, the bedding area beneath the cow is cooled using heat exchange mats below the stall bedding. To reduce energy consumption, water flowing through the heat exchange mats is chilled using a novel Sub-Wet Bulb Evaporative Chiller. The second approach, targeted convection cooling, uses fabric ducting to direct cool air on the cows. The air is cooled using high-efficiency direct evaporative coolers. Both approaches promise significant water and energy savings, when compared to current approaches.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project advances management strategies for reducing thermal stress in dairy cows while also reducing energy and water use. There are two methods of reducing thermal stress in cows: (i) lowering the cow's heat exposure and (ii) increasing the cow's ability to get rid of excess body heat. Current practice includes use of evaporative cooling with water sprayed on the cows using feed-line soakers, and cooling is enhanced by convective heat transfer via large overhead fans. This project will test and demonstrate an innovative approach that

seeks to optimize the cow's ability to remove excess body heat by utilizing more efficient cooling technologies, and introducing alternate strategies for when and where to cool the cows. By combining these two approaches this project has the potential to significantly change the way dairy cows are cooled.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 4a, 4c

Lower Costs:

By optimizing cow cooling operations this project could reduce water use by up to 86 percent and energy use up to 38 percent. By reducing energy and water usage the dairy owners will see reduced utility, operating and maintenance costs. The conduction cooling approach has the potential to reduce water consumption by 73 percent and electricity consumption by 38 percent compared to the baseline. The targeted convection cooling approach has the potential to reduce water consumption by 86 percent and electricity consumption by 28 percent compared to the baseline.

Environmental Benefits:

This project could reduce greenhouse gas emissions by integrating novel energy efficiency cow cooling technology at dairies. This technology could reduce energy and water use over traditional cow cooling methods and thus reduce greenhouse gas emissions associated with avoided capacity needed at the generation and associated with the embedded energy in water. In addition to saving electricity, this technology has the potential to increase milk production due to reduced heat stress as well as reducing disease among lactating cows.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $191,936
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $356,896
Match Partner and Funding Split: Regents of the University of California (University of California, Davis): $164,710 (14.1 %)	**Match Funding:** $164,710
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	27 out of 35 bidders	Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

(1) US Patent 9,207,018 Sub-wet bulb evaporative chiller system with multiple integrated subunits or chillers.

(2) US Patent 8397677 B2 Thermal Conductive Cooling Method and System for Livestock Farm Operations

(3) Targeted Convection and Hybrid Cooling of Dairy Barns

Update:

Work continues to determine the most effective and market ready approach and technology for large scale demonstration at a dairy. After audits of several farms in the Galt area, and discussion with agricultural specific HVAC technicians, an additional technology strategy for cow cooling was identified and is being evaluated. This new approach has the potential to cost less and provide equivalent or better energy and water savings than had been obtained through the other methods. After this new approach has been evaluated a decision will be made to determine which technology will be implemented at full scale in summer 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Novel Membrane Technology to Improve Energy Efficiency and Water Savings in Wastewater Treatment Operations

[EPC-16-011]

Recipient/Contractor:

Kennedy/Jenks Consultants, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	9/1/2016 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Low-pressure membrane filtration, such as microfiltration and ultrafiltration, is used for drinking water, wastewater, and industrial water treatment. However, membrane treatment processes are energy intensive, largely due to membrane fouling (organic and inorganic) on the membrane surface and in the membrane pores which results in layered fouling that is difficult to remove and increased transmembrane pressure. The use of membrane treatment is likely to increase due to its ability to remove pathogens during drinking water treatment compared to conventionally used media filters, and to recent state initiatives to increase water reuse.

Project Description:

This project is demonstrating the performance of an innovative "amphiphilic" membrane (i.e., a combination of hydrophilic and hydrophobic properties) that keeps organic and inorganic foulants away from the membrane surface by incorporating an anti-adhesive. The amphiphilic membrane retards long-term foulant deposition, which allows for higher water flow through the membranes, increased water yield, and improved energy efficiency. The project demonstrates the effectiveness of the technology in treating surface water, backwash water and synthetic reclaimed water. Data is collected to document savings and benefits in order to encourage commercialization. Implementation of this technology does not require capital investment. Instead, treatment facilities could replace existing hydrophilic membranes with the amphiphilic membranes during routine scheduled membrane replacements.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

A survey by the American Membrane Technologies Association (AMTA) indicates that there are approximately 100 microfiltration/ultrafiltration treatment plants with a total design capacity of approximately 400 MGD, eight nanofiltration facilities (30 MGD), and over 100 reverse osmosis (RO) facilities (400 MGD) in California. As membrane treatment is energy

intensive due to fouling, this technology could reduce energy demand for membrane treatment processes while decreasing the water need for backwashing.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 3a, 4a, 4c

Lower Costs:

The technology could reduce the use of chemicals and the frequency of membrane cleaning as well as reduce the frequency of membrane replacement. The recipient estimates a 50% reduction in the frequency of membrane cleaning and replacement, resulting in lower operation costs. Assuming a 50 percent market penetration, 40 percent energy savings for membrane filtration treatment, and 20 percent energy savings for reverse osmosis treatment, the technology could annually save wastewater treatment facilities an estimated 44,000 MWh in California or approximately $6.6 million.

Environmental Benefits:

The technology could minimize chemical use for membrane cleaning and increase water yield by approximately 12 million gallons per day, or the amount of water for 58,000 people.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $304,611
EPIC Funds Encumbered: $882,430	**EPIC Funds Spent:** $483,266
Match Partner and Funding Split: California Water Services: $20,000 (2.0 %) BASF: $60,000 (6.1 %) Kennedy/Jenks Consultants: $18,600 (1.9 %)	**Match Funding:** $98,600
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 27 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 3

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The recipient has completed pilot demonstration using all the three waters (surface water, organic spiked water, backwash water) at the Cal Water site, Bakersfield. Pilot operating data on two ultrafiltration membranes (R&D membrane and standard membrane) has showed that, despite the R&D membrane outperforming the standard membrane during the initial testing period, performance decreased after a few cleaning cycles. The reason for the loss of performance may be because special chemical functional groups responsible for the R&D membranes fouling resistance and reduced pumping costs were lost during the membrane cleaning process. The draft final report is expected February 28, 2019.

APPENDIX B:
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Project Name:

Power and Water Saving Advanced Hybrid Air/Wet Cooling System

[EPC-16-012]

Recipient/Contractor:

Altex Technologies Corporation

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	9/12/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Advanced hybrid air/water cooling systems for refrigeration and power systems represent an important opportunity, as they have the potential to reduce electricity and water use, an important consideration in California and many other water challenged areas in the United States. However, conventional hybrid air/wet cooling systems have high capital and electric power costs, which constrain their use in many commercial/industrial and utility applications.

Project Description:

This project uses high performance porous fins to enhance cooling through water vaporization and mass transfer. By retrofitting the heat exchanger with a water spray feature, this project has the potential to reduce energy and water use of HVAC and refrigeration systems in California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The hybrid cooling system is estimated to reduce fan power through low pressure drop characteristics and save water by only using water evaporation when ambient air temperatures are high. The system aims to improve efficiency in commercial and industrial refrigeration and air conditioning systems.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a, 4c

Lower Costs:

This project has the potential to lower costs to building operators by reducing energy and water usage, leading to lower utility bills. Assuming a 20 percent penetration of commercial and industrial markets, power and water will be reduced by 8,371 megawatt-hours and 725 million gallons per year.

Environmental Benefits:

This project has the potential to reduce greenhouse gas emissions by integrating a novel technology for energy efficient heating, ventilating and air conditioning (HVAC). The reduction in demand will result in avoided electricity generation and the associated greenhouse gas emission reductions. The HVAC technology will also reduce water use compared to that of standard cooled chillers. Reduced water use will result in savings of embedded energy savings.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $529,685
EPIC Funds Encumbered: $999,994	**EPIC Funds Spent:** $805,732
Match Partner and Funding Split: Altex Technologies Corporation: $187,207 (15.8 %)	**Match Funding:** $187,207
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 27 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 5

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Altex will include pre-existing intellectual property. A patented advanced porous fin heat exchanger technology that enhances wet and dry cooling heat exchanger performance will be adapted for the application of interest by adding water spray features, to produce an effective hybrid air/water cooling system, called Altex Hybrid HEX (AHHEX).
Update: The hybrid heat exchanger system is operational and the team is adjusting parameters to optimize energy and water performance. During December 2018 a third party M&V team will validate site monitoring instrumentation and data collection procedures, as well as providing feedback on an updated test plan. After validation of site conditions and updating the test plan M&V will continue through Q3 of 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Integrating Smart Ceiling Fans and Communicating Thermostats to Provide Energy-Efficient Comfort [EPC-16-013]	
Recipient/Contractor: The Regents of the University of California on behalf of the Berkeley campus	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 9/8/2016 to 3/30/2020
Program Area and Strategic Objective: Applied Research and Development S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.	
Issue: Conventional thermostat-based control strategies for heating, ventilating and air conditioning systems use a narrow range of temperatures year-round that are prescribed by building operators, based on an assumed occupancy schedule. Operators and occupants typically do not optimize these schedules based on actual occupancy or actual occupant preferences for thermal conditions. At low speeds, ceiling fans may reduce heating energy use by de-stratifying room air temperatures. However, architects, engineers, and owners do not understand the effects of air movement from ceiling fans to predict energy and comfort impacts that might result from new and innovative approaches to comfort.	
Project Description: This project develops an optimal system configuration for smart comfort controlled ceiling fans integrated with learning thermostats. This system is to be tested and evaluated for energy performance and occupant acceptance in low income multi-family residential and small commercial buildings in disadvantaged communities in California. This research and development advances the solution's technology readiness level and support market adoption acceleration. A design guide and energy code language are to be developed to facilitate widespread adoption.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Smart ceiling fans integrated with smart thermostats represent the next generation of energy efficiency that provides space conditioning while minimizing the need for compressor based air conditioning systems. This project advances the state of knowledge and practical	

applications of an integrated strategy to retrofit applications, addressing occupant thermal comfort and HVAC energy use through innovative hardware and software. This project is a scalable energy retrofit solution for commercial and residential buildings. Installation does not require advanced, specialized training, appropriately trained contractors or installers can easily perform the task. Operations are simple and do not need users to understand controls, set-points, or programming. Simple installation and controls with documented savings and no sacrifice on comfort could increase acceptance of this technology.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 3a, 3e, 4a

Lower Costs:

Developing cost-effective configurations and best practices will reduce the cost of adoption and operation while reducing the simple payback, thus enabling building owners to invest in the technology at lower risk. The team estimates the integrated solution to provide energy savings up to 37% in cooling and 15% in heating, which could add up to 985 GWh of annual energy savings for California or approximately $148,000,000. The solution is a key component for passive heating and cooling design which supports CA zero-net energy (ZNE) goals and is demand-response ready.

Environmental Benefits:

Energy savings could add up to 719 million pounds of greenhouse gas emissions reduced assuming a 15 percent market penetration. Also, ceiling fans are enabling technology for compressor-free cooling with passive and/or radiant systems because they provide comfort at higher indoor temperatures, thereby reducing refrigerant purchase, use and disposal.

Consumer Appeal:

Automated learning controls make the technology operation easier for the customer and likely resulting in wider user acceptance. User acceptance is key to achieving broad adoption and meeting energy savings targets.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$188,176
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,888,683	$755,316

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:
Center for the Built Environment - UC Berkeley: $112,726 (5.1 %)
BIG ASS FANS: $203,200 (9.2 %)</td><td colspan="2">Match Funding:
$315,926</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
39 out of 39 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project is on track. The research team completed laboratory testing of the integrated thermostat and fan system. Data loggers, sensors and other monitoring devices were installed in July 2017 at all sites, and 12 months of baseline energy data was collected. Ceiling fans and thermostat installations were completed in August 2018 at all five sites. Data from all sites is being collected and analyzed. Data collection will occur for a period of 12 consecutive months.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

A New Solution to California's Energy and Water Challenges: Reducing the Cost of Desalination and Increasing Water Reuse

[EPC-16-014]

Recipient/Contractor:

Lawrence Livermore National Security, LLC

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	9/1/2016 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Desalination is currently the primary method of removing salt from industrial and municipal wastewater for reuse. However, this technology is energy intensive and expensive. Industrial processes and household activities continuously add salt to water, and as a result, the salt content of industrial and municipal waste water is often too high for reuse. The salt content of this waste water must be reduced to enable recycling and to avoid ecological damage but the technology must be more energy efficient compared to current practice.

Project Description:

This project is demonstrating how to reduce the energy used to remove salt from wastewater using the flow-through electrode capacitive desalination (FTE-CD) technology. This advanced technology removes salt from water by applying an electric field to two porous electrodes. The electrodes act like a magnet for salt while the field is applied and remove the salt from water that flows through the electrodes using less energy and less costly than reverse osmosis (RO). Energy use of an FTD-CD system is projected to be 50% less compared to the energy use for an RO system. The recipient is partnering with two water districts to test the use of FTE-CD devices to desalinate wastewater and determine how this small, flexible device can improve the energy and operating efficiency of wastewater treatment solutions for communities. Wastewater from the industrial and municipal sectors will be used to test the technology along with measuring energy use and performance, such as fouling and other operation issues.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The FTE-CD technology has the potential of reducing the cost and energy use associated with desalinating water with low to moderate salt content and will represent an advancement

over current RO technology. This can increase the potential to increase water recycling and reuse at the community or industrial level, which could reduce the need to procure and transport fresh water sources. Also, this advanced FTE-CD technology is small and flexible which means that it can be customized to the scale needed for each community or industry, thereby increasing a community's water reuse potential which can increase drought resilience for the state.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4d

Lower Costs:

The FTE-CD system is projected to use 50 percent less energy than reverse osmosis (RO). Also, the technology is less costly than RO and operational costs are expected to be lower due to fewer chemicals used.

Environmental Benefits:

FTE-CD is expected to produce less wastewater than reverse osmosis due to higher water recovery rates. Also, FTE-CD can remove toxins from water such as nitrates and heavy metals, and could be deployed specifically to mitigate such hazards.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $448,176	
EPIC Funds Encumbered: $999,040		**EPIC Funds Spent:** $750,000	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 27 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 6

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The recipient has designed and modified end plates to facilitate parallelization of electrodes and tested a setup with five electrodes in parallel to compare performance to an individual cell. Salt removal and charge efficiency of the parallel setup was approximately the average of the individual cells, but the total resistance was higher than expected, leading to a 50% higher energy cost compared to single cells. This resistance can be decreased if the leads to the cells are soldered together rather than just twined. The recipient has produced multiple electrode pairs at 8 x 12 cm electrode size and anticipate that the full device will require about 20 of these electrodes.

APPENDIX B:
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Project Name: Los Angeles Regional Energy Innovation Cluster [EPC-16-015]	
Recipient/Contractor: Los Angeles Cleantech Incubator	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 8/17/2016 to 3/31/2022
Program Area and Strategic Objective: Market Facilitation S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.	
Issue: The Los Angeles region lacks the necessary coordination of technical, business, and social support services for clean energy researchers and entrepreneurs to develop clean energy innovations and the business opportunities resulting from them. This lack of organizational support prevents the Los Angeles region from clearly understanding the best direction for its clean energy economy. A coordinated effort is needed to determine regional energy needs, foster the size and strength of its current clean energy ecosystem, and provide a full, curated range of technical and commercialization services that are currently not available for clean energy entrepreneurs.	
Project Description: This project establishes the Los Angeles Regional Energy Innovation Cluster to act as a regional hub of the clean energy ecosystem and to give promising clean energy entrepreneurs in Los Angeles, Orange, Santa Barbara, and Ventura counties direct access to the region's top technical, business, outreach, and commercialization support services. This project assesses and addresses the region's energy needs by making use of and expanding resources for entrepreneurs and startups, including facilities, coaching, business support, speaking and networking engagements, and information about funding opportunities, all through connections facilitated by the Los Angeles Cleantech Incubator.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. This project will	

<table>
<tr><td colspan="2">also support technologies based on the regional energy market needs and engage a diverse group of clean energy stakeholders to provide the support, network, and resources needed for accelerated clean energy commercialization.</td></tr>
<tr><td colspan="2">CPUC Proceedings addressing issues related to this EPIC project:
Integration of Distributed Energy Resources (IDER): R. 14-10-003 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="2">Applicable Metrics: CPUC Metrics- 2a, 3e
Lower Costs:
This project will reduce the time and cost of new energy technology development by providing entrepreneurs with access to facilities, resources, and services needed to commercialize their innovation.

Economic Development:
The services provided by this cluster will support the development of local companies and job creation, and further develop the clean energy economy throughout the Los Angeles region.</td></tr>
<tr><td>Assignment to Value Chain:
Demand-side Management</td><td>Total Budgeted Project Admin and Overhead Costs:
$541,645</td></tr>
<tr><td>EPIC Funds Encumbered:
$4,999,247</td><td>EPIC Funds Spent:
$599,249</td></tr>
<tr><td>Match Partner and Funding Split:
Los Angeles Cleantech Incubator: $165,290 (1.9 %)
Los Angeles County Office of Sustainability: $2,104,712 (24.3 %)
Southern California Edison: $300,000 (3.5 %)
California State Polytechnic University Pomona: $24,625 (0.3 %)
CSU Dominguez Hills: $24,625 (0.3 %)
California State University, Long Beach Research Foundation: $24,625 (0.3 %)
CSU Los Angeles: $24,625 (0.3 %)
CSU Water Resources and Policy Initiatives: $5,000 (0.1 %)
California State University, Northridge: $24,625 (0.3 %)
Cleantech Orange County: $597,998 (6.9 %)</td><td>Match Funding:
$3,658,099</td></tr>
</table>

<table>
<tr><td colspan="2">CSU Channel Islands: $49,500 (0.6 %)
LA Business Technology Center: $99,000 (1.1 %)
Los Angeles Cleantech Incubator: $99,000 (1.1 %)
Economic Development Corporation of Los Angeles County: $99,000 (1.1 %)
Community Environmental Council: $15,474 (0.2 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
2 out of 2 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
In 2018, the LA Regional Energy Innovation Cluster accepted its third cohort of portfolio companies to receive services, for a total of twenty-six startups who have engaged with this program to date. The program will continue to provide important technical and business services such as speaking and networking opportunities, access to business development resources, awareness of funding opportunities, and connections to local energy stakeholders. The program also recently off-boarded startups from its first cohort. The program helped these startups meet critical milestones, including advancement in technology readiness, expanded customer base and partnerships, increased staff, and follow-on funding. As of June 2018, startups receiving services from this program have received $9,376,000 in private follow-on funding and $1,348,000 in public follow-on funding.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Commercializing a Disruptively Low Cost Solar Collector

[EPC-16-016]

Recipient/Contractor:

Hyperlight Energy

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	10/14/2016 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Concentrated Solar Power (CSP) is a promising form of renewable energy that has been hampered by high solar collector costs and high power block costs. In addition, there is need to enable use of geothermal power plant turbines that are underutilized due to resource decline at many sites in California.

Project Description:

This project has developed a low cost Concentrated Solar Power (CSP) collector to advance the market readiness of this technology. Hyperlight's CSP collector is based on the linear Fresnel reflector (LFR) and is able to make cost reductions through breakthroughs in materials, design, manufacturing and installation. A major innovation of the system involves use of mirrors attached to UV stabilized and low-cost plastic tubes that are mounted on sealed water bed foundation. The project has developed: (1) a single 1,000 square foot module used for lifecycle testing and validation of upgraded design elements; (2) a one half acre system for pilot testing and demonstration; and (3) a front end engineering design study to establish the feasibility and what is needed to scale the system up to ten acres and co-locate with other renewable energy such as a geothermal facility. EPIC funds are being used as cost share funding to Hyperlight's $1.5 million grant from the US DOE.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will lead to technological advancement and breakthroughs by advancing a low cost CSP collector to commercial availability. In addition to the value of demonstrating the collector through the physical installation, the front end design study and the availability of this low cost collector is intended to enable geothermal power plant owners to use this innovative system to boost the output of their plants and provide more renewable energy to the grid. The resulting increase in heat transfer fluid temperature from 200 to 300 C expands the market for this technology from food processing to biofuel process plants and petroleum refining.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 4a
Lower Costs:
This project will develop solar collectors that are roughly half the cost of current collectors, reducing overall system costs for concentrated solar to $99/m2 compared to existing cost of $200/m2. The LCOE from this technology is expected to be 6 cents per kWh compared to current state of the art CSP cost of more than 20 cents per kWh. The increased efficiency from 30 percent to 50 percent will help in reducing the solar field costs as well as land impacts of CSP.

Environmental Benefits:
This project will generate 3,500 mmbtu of heat per year, resulting in 50 tons of CO2 offset annually.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$177,896</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$750,000</td><td colspan="2">EPIC Funds Spent:
$581,326</td></tr>
<tr><td colspan="2">Match Partner and Funding Split: N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
United States Department of Energy: $1,500,000
Combined Power, LLC, dba Hyperlight Energy: $752,694</td><td colspan="2">Leveraged Funds:
$2,252,694</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
43 bidders</td><td>Rank of Selected Applicant/ Bidder:
N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. System and method of generating energy from solar radiation.
Update: Extensive optical, mechanical and thermal models were built that showed feasibility of technical targets. A prototype reflector of 20 feet by 50 feet was tested to 10,000 cycles representing a 30-year lifetime, and results of the testing showed minimal degradation. The project site preparation work was completed and the pilot system is operating as designed.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Maximizing Energy Efficiency and Reducing Bio-solids Waste from New Anaerobic Wastewater Treatment Technology

[EPC-16-017]

Recipient/Contractor:

Silicon Valley Clean Water

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	11/10/2016 to 3/1/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Based on 100-year-old technology, wastewater treatment has consumed abundant water, energy, and land, and fails to capture the significant energy resource value of wastewater. The result are systems that: 1) are energy-intensive, consuming 3 percent of electricity nationwide and generating significant amounts of greenhouse gas emissions, 2) produce large quantities of biosolids with high energy, greenhouse gas emissions, and monetary disposal costs, 3) neglect the value of wastewater as a reliable local water supply, nutrient resource, and energy supply, and 4) are at the end of their design life.

Project Description:

This project is demonstrating the elimination of aeration and its high energy demands as part of secondary water treatment at the Silicon Valley Clean Water wastewater treatment facility using a novel staged Anaerobic Fluidized Bed Membrane Bioreactor. This System is projected to generate 30 percent less bio-solids than conventional systems that require aeration. This project also seeks to demonstrate the potential for development of a new high quality local water supply through non-potable and advanced potable reuse treatment trains that eliminate process steps that normally precede the use of reverse osmosis.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project has the potential to lower energy costs of wastewater treatment and water recycling. The advanced technology used in this project is the Staged Anaerobic Fluidized Bed Membrane Reactor (SAFBMR) which eliminates the aeration stage of wastewater treatment. The aeration stage is one of the most energy intensive steps in wastewater treatment. The SAFBMR also has the potential to reduce operation and maintenance costs because bio-solids waste, which typically requires off-site disposal, is reduced, and the

effluent does not require the typical microfiltration pre-treatment step prior to the reverse osmosis systems.

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a, 4c, 4e

Lower Costs:

The technology has the potential to lower facility operating costs due to the removal of the aeration step from processing wastewater, the reduction of bio-solids that must be disposed, and the increased yield of methane biogas - a potential fuel source for on-site energy generation. The recipient estimates that a 1 million gallon per day treatment facility could achieve annual electricity savings of up to $185,000 from both efficiency and renewable energy generation over a 20 year life cycle. In addition, the technology is also estimated to result in 10 percent lower cost in capital and operation and maintenance cost compared to existing processes.

Environmental Benefits:

The lower energy use along with onsite renewable energy production will reduce greenhouse gas emissions. This project also will reduce biosolids waste that is typically trucked for off-site disposal. Additionally, the project will also produce higher quality water for potential potable uses.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $327,386
EPIC Funds Encumbered: $1,999,962	**EPIC Funds Spent:** $288,685
Match Partner and Funding Split: Leland Stanford Junior University: $400,000 (12.4 %) Santa Clara Valley Water District: $100,000 (3.1 %) GE Water: $210,000 (6.5 %) LG Water Solutions: $10,000 (0.3 %) Silicon Valley Clean Water: $499,943 (15.5 %)	**Match Funding:** $1,219,943

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
8 out of 8 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The Research Team has finalized and submitted the Benchmark Report characterizing the performance and costs of existing systems used to treat wastewater for water reclamation and reuse. The design of the SAF-MBR system has been completed and the construction of the SAF-MBR pilot facility at Silicon Valley Clean Water's waste water treatment plant in Redwood City has begun. Installation is expected to be completed in second quarter of 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Biological Double-Efficiency Process as an Advanced Wastewater Treatment Method to Achieve Substantial Energy and Water Savings

[EPC-16-018]

Recipient/Contractor:

BDP Technologies

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	11/21/2016 to 4/1/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

The most common secondary wastewater treatment process for nutrients removal is the activated sludge process. Most activated sludge processes are energy and land/space intensive as they include separated anoxic and aerobic tanks with secondary clarifiers. The infrastructure requires high capital, land footprint, and embedded energy and operation and maintenance costs. The current challenge for wastewater treatment plants in California is to meet the demand from population growth, increasingly stringent regulations and aging infrastructure while potentially reducing the energy and water consumption.

Project Description:

This project is demonstrating an efficiency technology that targets one of the major energy using steps in wastewater treatment. The Biological Double Efficiency Process (BDP) combines state of the art, easy to maintain aeration technology, airlift circulation/dilution technology, and an integrated all-in-one bioreactor technology to replace the separate anoxic and aerobic tanks associated with secondary clarifiers. The BDP is based on simultaneous nitrification/denitrification principles.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The innovative BDP technology has the potential to provide substantial energy savings to wastewater treatment plants, including reducing 50 percent of the aeration required for secondary treatment, thus decreasing electrical energy requirements and greatly improves oxygen transfer efficiency to 48-52 percent compared to 20-30 percent in conventional technologies.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs:

The BDP technology could reduce energy and water consumption and costs at wastewater treatment plants while also meeting California's growing water and wastewater needs. In addition, the BDP technology could provide advantages of reduced energy and land use, carbon footprint (CO2 emissions), waste sludge generation, and operation and maintenance costs. The technology has the potential benefits of substantial 50 percent energy reduction, 30 percent less capital, 50 percent less land required, 50 percent reduction in operation and maintenance costs, and water savings opportunities.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $15,486
EPIC Funds Encumbered: $1,565,400	**EPIC Funds Spent:** $786,669
Match Partner and Funding Split: BDP Technologies: $330,904 (17.4 %)	**Match Funding:** $330,904
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 8 out of 8 bidders	**Rank of Selected Applicant/ Bidder:** Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

APPENDIX B:
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Update:

The drilling of the Basin was completed and the recipient is revising the electrical plan per owner specifications. Construction is expected to be completed by the end of 2018. The recipient is on budget and schedule and is working on securing the air and water permits.

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Project Name: 21st Century Solutions for 20th Century Wind Projects [EPC-16-019]	
Recipient/Contractor: The Regents of the University of California on behalf of the Davis campus	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 2/13/2017 to 5/30/2019
Program Area and Strategic Objective: Applied Research and Development S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.	
Issue: California has a large population of aged wind turbines. According to the American Wind Energy Association project database, there are approximately 4,500 sub 300 kW turbines operating in California with rudimentary control systems. Those old turbines lack remote communication and control systems and cannot be remotely dispatched on and off. During periods without wind, the turbines remain online and energized, drawing grid power at high retail rates and costing owners up to $100,000 per year.	
Project Description: This project aims to develop inexpensive, standardized turbine upgrades that will allow aged turbines to behave more similarly to modern turbines by dispatching on/off when it is beneficial. The upgrade is a low-cost, robust, wireless communication and control system. The project includes installation of wireless communications and a field demonstration of the turbine upgrades and the forecasting algorithm at an operating wind plant in collaboration with CAISO and wind plant owners. A field test is at an operating wind farm in the Tehachapi region.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Through development of an innovative, real-time dispatch system for legacy turbines and implementation of a low-cost, robust form of remote communication and control, this agreement addresses the inability to efficiently and quickly on and off dispatch turbines when grid and market conditions demand. The project will deliver a low cost standardized communication and control system for aged turbines capable of remote on/off dispatch, and create a grid, market, and weather forecasting system to enable automated dispatching of turbines in response to oversupply and low/no wind conditions.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1c, 3a, 3f, 4a, 5c
Lower Costs:
The project will implement low-cost and reliable over-the-air remote communications and control for legacy wind turbines. The systems developed under this project reduced costs of communication and control systems for legacy turbines by 70 percent if compared with existing systems. The turbine controller is composed of a radio module with a cost of $42/unit, interface electronics costing $300 per unit, antenna and cable totaling $10, and a free software. This significant reduction in cost of control systems and increase in data quality might increase the use of control systems in legacy turbines.

Greater Reliability:
The upgrades implemented in this project will increase grid reliability by enabling dispatchability of legacy turbines from online to offline during periods of oversupply to reduce the need for other adjustments on the grid to respond to the excess wind generation. This contributes to improvement in overall system flexibility and reliability. The forecasting algorithm of negative pricing events developed under this project saved $351.43 per MWh and forecasted 89 percent of negative pricing events.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$322,793</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$810,438</td><td colspan="2">EPIC Funds Spent:
$327,177</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Department of Mechanical and Aerospace Engineering - UC Davis: $124,916 (13.4 %)</td><td colspan="2">Match Funding:
$124,916</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
29 out of 32 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
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Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

DNV GL's Forecaster weather modeling and short term power prediction tools and software will be used to support creation of a model that can identify optimum periods for dispatching aged turbines on & off. The dispatch algorithm developed for this project will utilize Forecaster inputs, but could be operated with forecasts from other systems.

Update:

The communication and control hardware was installed on nine turbines at Windstream in Tehachapi, CA. Seven turbines were equipped with fully functional control systems, while the remaining two had the turbine start/stop capability disabled. Additionally, the project team chose three of the nine turbines located with a hill blocking their line of sight to the central office to confirm that the system could communicate beyond line of sight by passing data through intermediate nodes in the mesh network. The project team has gained knowledge and experience in the field demonstration and had to overcome some unexpected hurdles with legacy technology, such as the need of upgrading the electric meter and power supply since modern micro components run in lower power, and some legacy technology has the older style of electric meter and/or power supply.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Recovery of Lithium from Geothermal Brines

[EPC-16-020]

Recipient/Contractor:

SRI International

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	1/16/2017 to 8/12/2019

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

Expansion of geothermal energy production in California will greatly benefit from the creation of a value stream produced by the recovery of useful metals from geothermal fluids. The efficient separation of metals, such as lithium, from geothermal brines promises to make the production of geothermal power economically favorable, even from low-temperature geothermal fluids. Revenue will be produced from the sale of the marketable metals, and the scaling and re-injection issues associated with the high-solid-content brines will be minimized.

Project Description:

This project demonstrates a cost-effective integrated process for the recovery of lithium from geothermal brines based on: (1) new high-capacity selective composite sorbents comprised of inorganic lithium-ion sieves and lithium-ion-imprinted polymers; and (2) a new sorbent regeneration process using eco-friendly carbon dioxide/carbonic acid that will lead to the direct formation of high-purity lithium carbonate (Li2CO3). Compared to traditional methods of Li recovery from brines, the proposed high-capacity selective sorbents and their regeneration process are expected to lower the cost of Li production by enabling online separation with higher recovery efficiency, using smaller volumes of sorbents and minimizing processing time. The project demonstrates a lab-scale integrated separation process for the production of high-purity Li2CO3 from geothermal brines.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will lead to technological advancement by enabling co-production of power and high-value metals from geothermal resources. The co-production of metals will improve the economic viability of geothermal power production, therefore increasing the penetration of geothermal renewable energy.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 2a, 3g

Lower Costs:

The technology being developed by the project will lower the cost of geothermal power production as a result of the recovery of useful metals from geothermal fluids. The economic value of the Salton Sea minerals is estimated at $1.5 billion. This is higher than the economic value of the net combined 327 MWe produced by the 10 power plants operating in the Salton Sea Known Geothermal Resource Area.

Economic Development:

According to a 2008 feasibility study sponsored by the Imperial Irrigation District, developing geothermal resources could result in creation of some 7,000 to 9,000 jobs, many of which would likely be higher paying than typical jobs in the county. A number of these jobs are likely to be in communities to the north, east, and south of the Salton Sea; areas that meet the CalEnviroScreen designation as disadvantaged communities.

Environmental Benefits:

Additional geothermal energy sources in the Salton Sea Known Geothermal Resource Area will reduce air pollution, which may improve the health of people in affected zones. Revenue from the land leases and mineral recovery is expected to support Salton Sea restoration projects, which some sources estimate may cost on the order of $3 to $9 billion.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $453,318
EPIC Funds Encumbered: $873,387	**EPIC Funds Spent:** $532,502
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	29 out of 32 bidders	Group 2: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has finished testing sorbents using synthetic brines to characterize specific surface area, selectivity, capacity, and adsorption kinetics. They have also completed sorbent regeneration testing to determine the regeneration kinetics, sorbent stability, and the purity of the lithium carbonate product. The project is integrating adsorption, regeneration, and product crystallization into a single process and expects to complete testing with actual geothermal brine by early 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network

[EPC-16-021]

Recipient/Contractor:

Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	2/13/2017 to 9/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

In operating geothermal fields, there is presently no method for imaging the movement of water and steam in a fractured geothermal reservoir in time and three-dimensional space. Tracer tests provide ground truth information about inter-well connectively, but they do not directly reveal the flow paths in the regions between the wells. Microseismicity mapped in three-dimensions can provide valuable information about fluid movement, but it is possible for water and steam to move through the fractured rock mass without triggering microseismicity, as well as for microseismicity to be triggered without fluids.

Project Description:

This project advances the current state for imaging subsurface flow paths, barriers, and heterogeneity in operating geothermal reservoirs through an integrated approach that combines the recent development of low-cost, dense seismic networks together with established state-of-the-art micro-earthquake imaging algorithms and rock physics concepts. The technical advancement of this project is the integration of these components into a system that can be cost-effectively, reliably and routinely deployed in operating geothermal fields to image the movement of fluids in space and time with high-resolution and fast-turnaround time from data collection, to processing, to imaging, to rock physics interpretations.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will provide tools to help geothermal operations to be more productive. This project will demonstrate the advantages of a micro-earthquake imaging system that uses a dense network of seismic stations and automated processing to perform fast-turnaround, high-resolution imaging of fluid movement in producing geothermal reservoirs.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 2a, 3a, 3b

Lower Costs:

A better understanding of the subsurface flow paths will allow them to optimize production activities and improve well targeting to drill more productive wells. Drilling wells with a 5-10% efficiency increase (whether in steam production or water injection wells) is a reasonable assumption with improved well targeting. At a 10% efficiency increase, 1 well in 10 could be eliminated from the drilling program. The Geysers well drilling program generally includes, at minimum, the equivalent of 10 deep wells and 5 shallow wells in 5 years. Deep wells cost approximately $6,500,000, while shallow wells cost approximately $3,000,000 to drill.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $537,304
EPIC Funds Encumbered: $1,672,639	**EPIC Funds Spent:** $810,000
Match Partner and Funding Split: Jarpe Data Solutions: $50,000 (2.9 %)	**Match Funding:** $50,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 29 out of 32 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

Installation of the micro-earthquake stations at the demonstration site is complete and data has been retrieved. P-wave and S-wave velocity tomograms show improved resolution. The first visualizations of tomograms in terms of Vp, Vs, and elastic moduli were performed. The project will continue to refine, optimize, and benchmark the MEQ processing & imaging code base.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Comprehensive Physical-Chemical Modeling to Reduce Risks and Costs of Flexible Geothermal Energy Production

[EPC-16-022]

Recipient/Contractor:

Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	2/13/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

The increased use of intermittent renewable energy (primarily wind and solar) increases the inherent variability and uncertainty in electricity demand and resource availability, and thus drives the need for operational flexibility of other renewables such as geothermal energy. Converting production from baseload to flexible production may result in significant changes to the system related to corrosion and mineral deposition (scaling) in wells, and mechanical fatigue damage to well components or the reservoir. A better understanding of the impacts of flexible-mode production on the reservoir-wellbore system is needed to assure safe and sustainable production.

Project Description:

This project seeks to address the specific challenges of base-load and flexible-mode geothermal production, including wellbore and reservoir integrity, scaling, and corrosion. An improved THMC model is being developed and applied to better understand these issues. Flexible mode production typically includes daily cycles in production rate that result in extraordinary stress on the wellbore and reservoir system. The modeling and assessment is being conducted to predict short- and long-term impacts of flexible-mode production on liquid-dominant geothermal reservoir systems representative in California and the site-specific vapor-dominated Geysers Geothermal Field with flexible production pilot test data.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will lead to technological advancement by providing modeling tools that can be used by geothermal operators to better understand the impacts of flexible-mode production on the reservoir-wellbore system. Such knowledge allows the development of power plant and control technologies to enable geothermal power plants to operate in different variable modes, and to be both a base-load and flexible renewable resource.

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 3a, 5a, 5f

Greater Reliability:

Switching base-load production to flexible-model production for an existing geothermal power plant will allow for increased use of intermittent renewable resources. The installed capacity of geothermal power plants in California is sufficiently large to have a significant impact on electricity reliability.

Increase Safety:

The project will quantify effects of flexible-mode production on the well integrity, including corrosion and potential mechanical well failure. This leads to increased confidence on how to operate flexible production in a safe manner.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $480,995
EPIC Funds Encumbered: $999,032	**EPIC Funds Spent:** $450,000
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 29 out of 32 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Terms and Conditions.
Update: The modeling tools have been completed. The project is continuing to model simulations for base-load and flexible production, and for liquid and steam dominant geothermal systems. The project has begun modeling real field cases.

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Project Name:

San Gabriel Valley Water Company "Plug and Play" In-Conduit Hydropower Development Project (SGVWC Project)

[EPC-16-024]

Recipient/Contractor:

San Gabriel Valley Water Company

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	3/1/2017 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Typically, the 100 kW or less pressure reducing valves are located in above- or below-ground structures that were not designed for the addition of in-conduit hydroelectric systems. To adapt a water-to-wire system at these sites, resources are spent designing a custom powerhouse to include civil, mechanical and electrical equipment/systems. However, sub 100-kW sites often share characteristics that present an opportunity to integrate a standard civil, mechanical electrical powerhouse design (above or below grade), with an integrated water-to-wire system constituting a “plug and play” in-conduit hydroelectric packaged system.

Project Description:

The San Gabriel “Plug and Play” In-Conduit Hydropower Development Project aims to design, develop and demonstrate a modular, cost-effective in-conduit hydroelectric system designed for the sub-100-kW in-conduit hydroelectric market that will decrease the civil, mechanical, electrical and interconnection costs. San Gabriel Project includes a new 73 kW modular “plug and play” in-conduit hydroelectric station at a space-constrained site in an urban, potable water system, that will provide an estimated 381,000 kilowatt-hours (kWh) of renewable generation, while also providing a model that can be deployed to many undeveloped, small sub-100 kW in-conduit sites throughout the state.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State’s Statutory Energy Goals:

The project will recover wasted energy from an existing pressure reducing station, thereby addressing a key component of the Water-Energy nexus, an on-going proceeding at the CPUC and Energy Commission. The recipient estimates there to be about 120 similar-sized pressure reducing opportunities within California representing 9,000 kilowatts that will become economically viable if the project is able to meet its cost reduction goals.

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<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1a, 1b, 2a
Lower Costs:
This project is expected to benefit IOU electricity ratepayers by reducing the cost of sub 100 kilowatt hydropower by an estimated 20 percent.

Environmental Benefits:
Over the course of its 30-year asset life, the 78 kilowatt hydropower project is expected to reduce CO2e emissions by 8040 metric tons.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$13,082</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$500,000</td><td colspan="2">EPIC Funds Spent:
$255,064</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
San Gabriel Valley Water Company: $612,000 (47.7 %)
NLine Energy, Inc.: $170,000 (13.3 %)</td><td colspan="2">Match Funding:
$782,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
29 out of 32 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

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Update:

The overall design of the project has been delayed due to the initial late start of the project as well as the need for completion of the water balancing study. With a turbine lead time of 6 months, a decision was made to push the project construction to fall 2018 to ensure that San Gabriel Valley Water Company can meet peak demands in the summer time. The project is expected to be commissioned in the first quarter of 2019.

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Project Name:

Comprehensive Assessment, Tools and Resources for Advancing In-Conduit Hydropower in California

[EPC-16-025]

Recipient/Contractor:

Stantec Consulting Services Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	2/13/2017 to 10/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Less than 5% of the 255 MW in-conduit hydrogeneration potential forecasted has been approved for development since 2013. Although the regulatory, environmental, technical and financial environment incentivize stakeholders, the total market penetration is still under 10% of potential. A number of agencies have compiled information on small hydropower systems, providing high level, directional guidance recommendations for on-site and equipment selection, commissioning, operation and testing. The limitations associated with the publically available guidebooks and tools must be addressed to assist users in making appropriate and informed decision.

Project Description:

This project aims to conduct a comprehensive assessment of in-conduit hydropower generation potential in California and develop a guidebook and a business case assessment tool that assist municipal, agricultural, and industrial water purveyors with the cost effective implementation of in-conduit hydropower generation projects. The proposed guidebook and the business case assessment tool will provide invaluable knowledge base for municipal (water and wastewater), agricultural and industrial agencies that are considering capturing hydrokinetic/hydrostatic energy and integrating in-conduit hydropower into the existing energy mix. The Business Case Assessment Tool will assist users with building a business case for implementation of an in-conduit hydropower project, providing qualitative and quantitative guidance on the selection of equipment and sites for fit-for-purpose applications.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Newer in-conduit hydroelectric turbine technology research and development has not been adequately covered in any published guidebook. The available guidebooks do not include

many of these novel technologies nor do they include performance information, associated equipment, siting criteria, civil, mechanical and electrical design considerations, costs or other relevant information that will assist California's stakeholders in determining which in-conduit hydroelectric technologies are best suited for a particular site.	
CPUC Proceedings addressing issues related to this EPIC project: Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]	
Applicable Metrics: CPUC Metrics- 1a, 3a, 3b Lower Costs: The development of a clear, concise and transparent guidebook for assessment of in-conduit hydropower in California will enable electricity ratepayers to benefit from effective deployment and avoid the risk of failed projects. Developing the tools for evaluating the economic and environmental impacts of in-conduit hydropower generation will help ensure that projects are cost-effective and reduce costs for California ratepayers. Greater Reliability: Deployment of justified in-conduit hydropower could provide a source of capacity and renewable energy that is not fundamentally intermittent. In-conduit hydropower projects could provide resource diversity benefits to system reliability. California has the potential to install 414 MW of in-conduit hydropower across 450 different locations.	
Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $121,338
EPIC Funds Encumbered: $400,000	**EPIC Funds Spent:** $297,103
Match Partner and Funding Split: Stantec Consulting Services Inc.: $35,372 (7.3 %) NLine Energy, Inc.: $19,104 (4.0 %) Leland Stanford Junior University: $28,542 (5.9 %)	**Match Funding:** $83,018
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	29 out of 32 bidders	Group 1: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team estimates the in-conduit hydropower potential in California by analyzing the on-site survey data collected by NLine Energy, the results from a questionnaire presented by the team and distributed to various water agencies, as well as crossing data from USGS, DWR and SWRCB database. The estimate concluded that while there is at-least 343 MW of installed in-conduit hydropower facilities in California as of 2017, there is potential for further installations up to 414 MW across 450 different locations. The team also conducted eight case studies, which identified that small in-conduit hydropower projects should consider multiple scenarios at the feasibility stage to investigate different hydrologic conditions, and interconnection costs can vary considerably.

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Project Name:

Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants

[EPC-16-026]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/15/2017 to 12/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

During periods of peak electrical usage, matching supply and demand for the electric power grid has become increasingly challenging due to increasing penetration of variable renewables into the supply mix. Demand response (DR) provides an opportunity to mitigate grid instability and the high cost of purchasing electricity at critical times. California's industrial sector has the potential to provide fast and flexible DR through the development of control strategies.

Project Description:

This agreement develops and pilots tests integrated control strategies for demand response (DR) at two demonstration sites in California: a water pumping station and an industrial refrigerated warehouse. Both test sites have built-in energy storage capabilities. The pumping station stores energy in water pumped uphill, while the refrigerated warehouse stores energy as thermal mass in frozen food. The capacity for storage allows for temporary shed, shift or adjustment in power demand. The proposed technology will integrate controls, energy cost, historic load data, and tariff information to allow for optimized demand response. These control strategies are expected to be practical and technically feasible.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project develops technology that will enable industrial customers to provide automated DR service to the grid including fast ramping, operating reserves, frequency regulation, and peak load reduction in support of California's goals for DR and energy efficiency as well as renewable integration and greenhouse gas emissions reduction.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1g
Lower Costs:
The project has the potential to reduce demand for a variety of grid use cases including fast ramping, operating reserves, frequency regulation, and peak load reduction. This can result in lower demand charges and energy costs to the customer.

Greater Reliability:
Supporting fast and flexible demand response helps to augment power system reliability and results in less stress on the grid by reducing peak loads. These services can help with maintaining system reliability.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$884,720</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$3,000,000</td><td colspan="2">EPIC Funds Spent:
$0</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Southern California Edison: $300,000 (8.7 %)
San Diego Gas & Electric Company: $15,000 (0.4 %)
Electric Power Research Institute, Inc.: $150,000 (4.3 %)</td><td colspan="2">Match Funding:
$465,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Phase 1 Group 2: Ranked # 5</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project is on schedule. 1.The water pumping station team is evaluating the water system components, operating speeds of variable speed pumps in relationship of speed to power consumption, and flow rates. In October, 2018, the team met with California Water Service staff to obtain feedback on the feasibility of day-ahead DR targets, additional data to be collected and requested tank level data. 2.The refrigeration site team continues to analyze the utility meter data to understand impacts of current controls on the load profile. The team is planning tests with DR signal to the refrigeration units at the site. They are preparing deliverables: technology/knowledge transfer plan, the site installation and interface summary data, and operator interview findings.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Facilitating On-farm Participation in Energy Demand Management Programs

[EPC-16-027]

Recipient/Contractor:

Irrigation for the Future, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/3/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Irrigated agriculture represents a significant source of energy-use and peak demand in California. California's level of irrigation management is advanced relative to the rest of the country, with 40% of irrigators using some form of scientific irrigation management when deciding when to irrigate. To reduce energy and water use further, partial irrigation timing strategies, such as deficit irrigation, are needed. Partial irrigation strategies can reduce energy use or shift demand times while maintaining or increasing farm profits, but these benefits are not well documented.

Project Description:

This project develops a management tool for optimizing irrigation at 10 farms in California. The sites have varied water requirements, growing a mix of almonds and alfalfa. The project is validating a pre-commercial water management system that allows irrigators to have more flexibility over when they irrigate and use energy. Instead of adding water whenever the soil is dry, this system will manage plant stress so that water can be delivered when costs are low and when needed by the plant. The purpose of the management technology is to enable irrigators to participate in utility incentive programs offering benefits to customers who can shift their energy demand. This management approach would enable participation in utility demand response, time of use, and automated demand response programs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The agreement tests an irrigation management system that facilitates use of partial irrigation strategies, enabling flexible energy load control. This will allow irrigators to participate in utility demand response and time of use programs while providing flexibility to the grid.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1b, 1e, 1f, 1g, 2a, 4c
Lower Costs:
This project could lower energy costs and demand through participation in utility incentive programs for time-of-use, demand response, and automated demand response. It could also reduce water use and cost by 15% per farm.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$166,426</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,588,872</td><td colspan="2">EPIC Funds Spent:
$381,486</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Irrigation for the Future, Inc.: $126,663 (7.4 %)</td><td colspan="2">Match Funding:
$126,663</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Phase 1 Group 2: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
The intellectual property contains copyrights to "Irrigation Management Online."</td></tr>
</table>

APPENDIX B:
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Update:

The research team continues to collect in-season measurement and observations at the cooperating farms in preparation for a full-scale field trial of the automated irrigation management system, Irrigation Management Online (IMO). This trial will employ the automated data integration and generate updated irrigation schedules which will be sent to the grower on-demand via the updated IMO interface. The IMO system will inform the growers of the water use and yield reduction consequences of participating in any particular DR or ADR event. The full-scale trial is expected to be implemented in 2019 and 2020 irrigation seasons.

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Project Name:

Irvine Ranch Water District Load Shifting and Demand Response Pilot Project

[EPC-16-028]

Recipient/Contractor:

Advanced Microgrid Solutions, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/7/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Water agencies operate within strict health, safety, and reliability and ratemaking constraints. Participation in demand response programs is not part of the core mission of water agencies and funding to increase demand response participation is not supported in the rate design. Electricity tariffs for water agencies intended to reduce peak demand are often at odds with the operating requirements of water and wastewater treatment facilities. Smart load control and demand response technologies are needed to automatically reduce peak demand, usage, and optimize cost, within existing tariffs and operational constraints of water agencies.

Project Description:

This project develops, tests, and validates a load-shifting optimization platform to reduce energy use and demand charges in the water sector. The platform advances pre-commercial demand response technologies to reduce: peak demand, energy use, and operational costs. The platform integrates advanced real-time monitoring, automated load shifting control, energy storage, and a pre-commercial cost optimization platform. Data generated by the project will validate the approach and identify best practices for increasing water sector participation in demand response programs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project integrates several pre-commercial and commercial technologies into a platform that enables operational equipment and energy storage resources to respond automatically to energy price signals. The integrated approach promotes greater participation in demand reduction events, including the ability to participate without prior-day notice.

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<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Demand Response (DR): R.13-09-011</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e, 1f, 1g, 1h, 4a
Lower Costs:
The project is estimated to reduce on-peak demand by 22 percent, or 650 kW; reduce energy usage 32 percent, or 267 MWh of electricity; and save $326,000 annually in reduced energy costs. The target market for this technology are the estimated 1,300 retail water and wastewater pumping, treatment, and storage facilities throughout California. If all eligible facilities statewide install the technology, the result would be 80 MW of reduced demand.

Greater Reliability:
The project will validate the ability of water agencies to participate in demand response events on an automated basis, enable a more rapid response, and allow for greater load reduction. This project has the potential to increase grid reliability by increasing participation in demand response programs and providing dispatchable load reduction.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$832,615</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,403,465</td><td colspan="2">EPIC Funds Spent:
$88,515</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Advanced Microgrid Solutions, Inc.: $752,919 (34.8 %)
Pam Seidenman Consulting: $7,650 (0.4 %)</td><td colspan="2">Match Funding:
$760,393</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Phase 1 Group 2: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project team has conducted energy audits of the pilot sites, modeled facility load profiles, and assessed which tariffs are most advantageous for reducing peak demand and energy. The largest pilot sites are on new tariffs that allow participation in the local capacity resource program. The team has begun design, engineering and installation of battery storage systems. They are analyzing site operation requirements, control diagrams and strategies, and evaluating control equipment for automated load control.

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Project Name:

Water/Energy Bank Proof-of-Concept

[EPC-16-029]

Recipient/Contractor:

Antelope Valley Water Storage, LLC

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/13/2017 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

The State Water Project (SWP) which transports water annually from the northern part of the state southward is California's largest user of electricity - about 2% of the State's anticipated 2020 peak demand. A significant portion of the electricity is used to pump water over the Tehachapi Mountains which involves a nearly 3000-foot lift in elevation. The issue is whether SWP contractors can be incentivized to shift their water delivery schedules to non-summer months to optimize energy benefits and whether there can be a guaranteed peak load reduction in the summer months when electric grid demand is at its highest levels.

Project Description:

This proof of concept study is evaluating the feasibility of using groundwater storage and cycling surface reservoirs to shift the State Water Project's Southern California water deliveries to non-summer months to reduce summer electric grid peak demand. Shifting the timing of water deliveries could reduce solar and wind power over-generation risk during non-summer months when renewable energy is in surplus. This project investigates the technical, institutional, legal and economic feasibility of implementing a guaranteed water delivery shift and develop demand response and load shifting tools and strategies to manage peak load and demand and thereby reduce energy costs in the water sector.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project could lower peak demand on the electric grid during Summer months when power demand is at its highest levels. This will increase the reliability of the electric grid system, reduce the use of peaker plants that operate on fossil fuels to meet system demand and operating margins, and lower Department of Water Resource's water transport costs by shifting electric demand to non-summer months when demand and energy rates are lower.

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CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1e, 1f, 4a, 5b

Lower Costs:

By implementing the recommendations found by this research study, the State Water Project (SWP) contractors could eliminate the need to meet peak electricity needs using fossil-fueled combustion turbines due to summer reductions of State Water Project pumping. Department of Water Resources costs to import water could also be reduced by using the lower rates for electricity available during non-summer months. Ratepayers would benefit from lower peak demand prices due to reduced grid load during peak periods.

Greater Reliability:

Implementing recommendations from the research study could improve electric grid reliability by providing a guaranteed summer pumping reduction that provides firm demand response to match the evening ramp up as solar arrays go offline. It is independent of natural gas availability - the fuel for the State's newer combined cycle power plants and higher polluting peaker plants. The water energy bank is a demand response resource that can address a grid emergency such as the loss of generation or transmission facilities to improve reliability.

Environmental Benefits:

Implementing the recommendations from this study has the potential to increase use of renewable energy generation during periods of over generation by pumping water through the State Water Project during these times. Use of renewable energy generation results in less use of fossil fueled combustion turbines to meet summer peaks.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $150,000
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $637,571
Match Partner and Funding Split: Antelope Valley Water Storage, LLC: $225,000 (18.4 %)	**Match Funding:** $225,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	phase 1: 27 out of 28 bidders	Phase 1 Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The technical report is complete and includes all the complex analysis for this project. Using the Edmonston pumping plant for the analysis, implementation of the recipient's recommendations would lead to an average peak load reduction of 60 MW from July to September based on a normal water year. A notable finding is the possibility of converting the Water-Energy Bank into an energy neutral operation through the use of 40 MW of solar arrays and 5 MW of hydropower. The draft final report will include information from the technical report and will be submitted in January 2019. The recipient presented the Water-Energy Bank concept at the Demand Response & Distributed Energy Resources World Forum on October 16, 2018 and plans to publish results in journals and disseminate results at conferences such as the American Water Works Association CA-NV spring conference.

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Project Name:

Enabling Energy Efficient Data Centers in Smart Power Distribution Systems

[EPC-16-030]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Riverside Campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/8/2017 to 12/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Data centers consume an estimated 2% (100 billion kWh) of total U.S. electricity with a cost of around $10 billion. The peak demand of data centers represents over 2% of peak load in California and is expected to grow 4% annually in the next ten years. Therefore, it is critical to develop energy efficiency technologies for data centers in California.

Project Description:

This project is researching and testing technologies that improve data center energy efficiency at three different levels in a smart power distribution system. The technologies include increasing server energy efficiency, through coordinated deep sleep and dynamic voltage-frequency scaling (DVFS); data center workload balancing through phase and load balancing across multiple servers in a data center; and geographical workload balancing through phase/load balancing in a single or multiple power distribution network or feeder.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Data centers are a major consumer of electricity. In the PG&E service territory, peak demand of data centers is around 500 MW, representing 2.5% of peak load consumption. The energy use from data centers is expected to increase by 4% annually in the next 5-10 years. The development of agile energy efficiency solutions for data centers is needed. This project provides unique software based solutions, rather than hardware solutions, to reduce electricity consumption by data centers through deep sleep and dynamic voltage frequency scaling, peak efficiency scheduling and spatial workload scheduling. If successful, potential electricity savings of up to 35% could result.

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1g, 2a

Lower Costs:

Much of the technology being developed by this project is software based that has the potential to lower data center processing energy usage and the costs associated with it. The recipient estimates that implementation of three proposed techniques could annually save data center operators over 1,000 GWh, resulting in estimated cost savings of $173 million if implemented at a 100%.

Environmental Benefits:

If the three proposed techniques are implemented, and saves data operators over 1,000 GWh annually it can result in a reduction of 365,863 metric tons of CO2 if implemented at 100%.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $306,631
EPIC Funds Encumbered: $1,783,118	**EPIC Funds Spent:** $178,943
Match Partner and Funding Split: The Regents of the University of California (UC Riverside): $265,567 (12.8 %) San Jose State Research Foundation: $31,497 (1.5 %)	**Match Funding:** $297,064
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	phase 1: 27 out of 28 bidders	Phase 1 Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project team has completed the modeling of the Peak Efficiency Scheduling Algorithm and have preliminary average results of approximately 15% overall energy usage reduction. The project team is now working on development of the load migration and the demand response algorithms.

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Project Name:

VOLTTRON Testing Tool Kit

[EPC-16-031]

Recipient/Contractor:

SLAC National Accelerator Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	3/31/2017 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

California's energy goals include high levels of utility-scale renewables and distributed energy resources (DER). These goals can be achieved only if the distribution utility can operate the grid reliably while supporting ever larger amounts of DER. Today's DER management and system integration projects are either not integrated with each other or are costly to implement, as it requires highly skilled labor to connect specialized equipment and program software to optimize system operation. As buildings and operations change, specialized software must be adjusted, tested, recalibrated for optimal use and performance.

Project Description:

This federal cost share project demonstrates the benefits of the VOLTTRON platform for DER management through the testing of the VOLTTRON Testing Tool Kit. VOLTTRON is a US Department of Energy funded open source platform intended to provide a software base for integrating management of energy demand in buildings, distributed energy resources, and the electrical grid. The tool kit includes simulation test suites, a platform monitoring and debugging tool, and more extensive database support to promote wider adoption of VOLTTRON platform beyond its original set of developers. By lowering implementation costs and adding easy adoption features, the tool kit encourages adoption by other users, including organizations and private entities seeking to develop DER integration projects.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Communication of DERs with grid operators is critical for successful utilization of distributed energy resources. DOE developed the VOLTTRON platform to facilitate such communication. However, the platform is in its early stages and requires additional support and an expanded user base to become widely adopted. The VOLTTRON Testing Tool Kit provides new tools to confidently run a high qualify open source project. All knowledge gained and software written will be pushed to GitHub for open source use. With the testing

tool kit, VOLTTRON becomes a more effective platform for DER management. This will enable higher utilization of DERs in support of the state's renewable energy and GHG reduction goals.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1d, 1e, 1f, 1g, 1h, 4a, 5b

Lower Costs:

This project can facilitate interoperability and reduce the cost of DER integration projects by approximately 30%. An open source integration platform, with strong technical support, can reduce the integration costs by creating a community of developers that reuse and enhance codes over time, savings cost of design, development, and commissioning.

Greater Reliability:

This project has the potential to facilitate adoption of DER management and integration projects, allowing the electric grid to continue operating reliably while supporting more utility-scale renewables and distributed energy resources.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $28,501
EPIC Funds Encumbered: $70,000	**EPIC Funds Spent:** $70,000
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: United States Department of Energy: $700,000 Kisensum: $105,000	**Leveraged Funds:** $805,000

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 43 bidders	**Rank of Selected Applicant/ Bidder:** N/A

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If not the highest scoring applicant/bidder, explain why selected: The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: A VOLTTRON hackathon (final project milestone) was held at SLAC on September 17, 2018. Participants received an initial orientation in VOLTTRON concepts and agent capabilities, and then were challenged to construct a system of VOLTTRON-linked DERs capable of demand response behavior. All tools developed for the Hackathon contributed back to the VOLTTRON open source repository on GitHub. The recipient is developing the final report for this agreement.

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Project Name:

Leading in Los Angeles: Demonstrating Scalable Emerging Energy Efficient Technologies for Integrated Facade, Lighting and Plug Loads

[EPC-16-032]

Recipient/Contractor:

New Buildings Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

The Los Angeles basin is in drastic need of energy and carbon reductions in the wake of the Aliso Canyon natural gas leaks. Deep building energy retrofits can realize large energy and carbon savings in existing buildings. However, barriers such as cost-effectiveness, unknown savings potential, and scalability have limited implementation of large scale building retrofits that would provide a significant impact.

Project Description:

The project team is demonstrating and validating new retrofit package solutions from laboratory pre-testing through field demonstrations in existing government-owned commercial buildings. The solution sets, dubbed "INTER", are comprised of shading products from Rollease Acmeda and lighting and plug load systems and integrated controls, including HVAC systems, from Enlighted. The technologies can be combined and customized to suit a variety of building types and spaces, resulting in an estimated whole building energy reduction of 20 to 32 percent. Beginning in the Los Angeles basin, the team is leveraging existing market connections to increase and accelerate market adoption of these retrofit solution sets to maximize the potential energy and carbon savings, first in the region and ultimately, throughout California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project creates a holistic, low-barrier integrated retrofit solution for significant energy savings. The scalable energy retrofit solution will be demonstrated in municipal government buildings but is also applicable to other commercial and residential buildings and to new construction and existing buildings. Installation does not require specialized training. The integration of technologies can produce higher savings than individual technologies operated

in isolation. This solution will support California's statewide zero net energy and existing building goals.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs:

The project could reduce annual energy use in a typical large office building by 32 percent. The lighting control system is demand response capable. If this suite of technologies is implemented statewide in existing buildings over the next 15 years, estimated savings include 2,692 GWh, $421 million, and 639,000 metric tons of CO2e, assuming a retrofit rate of just 3 percent annually.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$1,767,847
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$4,981,000	$1,254,932
Match Partner and Funding Split:	**Match Funding:**
United States Department of Energy: $50,000 (0.7 %) Rollease Acmeda, Inc.: $676,000 (10.1 %) Delos: $28,000 (0.4 %) Enlighted Inc.: $809,500 (12.1 %) Southern California Edison: $150,000 (2.2 %) TRC Engineers, Inc.: $12,000 (0.2 %)	$1,725,500
Leverage Contributors:	**Leveraged Funds:**
N/A	$0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	phase 1: 8 out of 10 bidders	Phase 1 Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project is on schedule. Testing the INTER system at LBNL's FLEXLAB started in October 2018. Accomplishments to date include meeting with manufacturers (Rollease and Enlighted) to obtain technical specifications and identify potential product tests and modifications, establishing FLEXLAB bench test methodology and priorities, creating selection criteria for demonstration sites including applicability of the technology packages, access to monitoring and verification and occupant feedback, and transferability of benefits to the larger California marketplace. As a result, ground work for the retrofit of several buildings at CSU Dominguez Hills and the City of Santa Ana started in August 2018. The first Technical Advisory Committee meeting was held in November 2018, and technology transfer plan has been submitted to the Energy Commission for review.

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Project Name:

Internet of Things and Ubiquitous Sensing in University Building Energy Management: Design Optimization and Technology Demonstration

[EPC-16-033]

Recipient/Contractor:

CSU Long Beach Research Foundation

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/30/2017 to 9/20/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Many existing building owners are reluctant to take on brand-new technologies or upgrades due to the need for additional in-house technical personnel and expertise. Even though new energy management technologies can reduce energy use and operating costs, there is reluctance to try new state-of -the art technologies based on internet of things (IoT).

Project Description:

This project develops and evaluates a pre-commercial energy management system at a building on the CSU Long Beach campus. The research uses energy efficient technologies with internet of things (IoT) controls in order to optimize load operation, load leveling, and peak shaving. The advancements in monitoring and controls from this project will enable deployment of similar systems at other academic facilities in California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project aims to remove barriers to achieve widespread deployment of state-of-the-art energy management technologies. The project provides California IOUs, academic institutions (universities, including 22 CSU campuses), energy management technology developers, and other stakeholders with an IOT-based energy management platform. Additionally, the project provides a comprehensive example of the potential for large scale deployment, including technical considerations, building performance, energy savings, and non-energy benefits.

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CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1g, 1h

Lower Costs:

The use of IOT-based controls is projected to reduce on-peak energy demand of HVAC by 100 kW and the peak demand of lighting and plug loads can be reduced by 125 kW. The total annual electricity and thermal savings are estimated at 570,000 kWh and 1,600 therms or approximately $163,000 annually.

Environmental Benefits:

Reduction in on-peak energy demand and electricity consumption could reduce the need to burn fossil fuels for electricity generation and result in an estimated 137 metric tons of CO2e reduced. Being able to shift electric loads anytime during DR events provides flexibility to the electric grid and the potential for increase renewable energy use during periods of over-generation.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $402,014	
EPIC Funds Encumbered: $2,509,946		**EPIC Funds Spent:** $0	
Match Partner and Funding Split: Enlighted Inc.: $411,500 (11.5 %) ControlWorks, Inc.: $88,500 (2.5 %) Regents of the University of California, Riverside Campus: $163,400 (4.6 %) CSU Long Beach Research Foundation: $409,558 (11.4 %)		**Match Funding:** $1,072,958	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 8 out of 10 bidders	**Rank of Selected Applicant/ Bidder:** Phase 1 Group 2: Ranked # 2

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The IoT LED lighting system and plug-in load controllers were installed on all four floors of the Engineering and Computer Sciences building at CSU Long Beach. The HVAC controls will be installed during the 2018-19 winter break. After installation is complete, the team will evaluate which loads and devices can participate in anytime load reductions during demand response events.

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Project Name:

Automated Cloud-Based Continuously Optimizing Building Energy Management System [EPC-16-034]

Recipient/Contractor:

Zero Net Energy Alliance, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/1/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Current building energy management systems (BEMS) are typically programmed and set to a predefined schedule to ensure set points are reached. However, most BEMS fail to optimize energy use because predetermined settings become rapidly obsolete. In addition, energy management systems do not detect when buildings and energy systems degrade over time, creating "drift" in the months and years following commissioning. Even state-of-the-art BEMS require regular reprogramming to achieve and sustain a high degree of energy efficiency.

Project Description:

This project is developing a software platform that helps building energy management systems run more effectively. The Automated Cloud-based Continuously Optimizing Building Energy Management System (ACCO-BEMS) automates and optimizes control of building systems and devices. It is being implemented at Pomona College in 11 buildings on campus, half of which will have ACCO-BEMS as a new building energy management system, the other half will have ACCO-BEMS integrated with the existing system.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Energy performance monitoring and fault detection diagnostics software is a key technology that must be further enhanced and deployed to overcome barriers to achieving ZNE buildings. A principal barrier to real-time management of energy systems is the many, often incompatible, protocols and interfaces used by energy devices and sensors. These have long represented a barrier to the integration of discrete systems, sensors and actuators necessary to automatically assess and control energy use. This project uses an internet-of-things gateway to communicate with the various energy using devices in the building using their native protocol and interface. The platform uses machine learning to assess real-time building performance and automatically adjust individual devices. The technology eliminates

building drift and negates the need for expensive reprogramming or optimization measures.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a

Lower Costs:

The project has the potential to reduce electric demand and enable real-time automated demand response (ADR). The technology is being demonstrated at two Southern California college campuses and is estimated to enable 1 MW of ADR with projected annual energy savings of 1,600 MWh or $250,000 per year. The target market for this technology is educational, non-grocery retail and office buildings--which represents 43% of the total statewide electric use. Once scaled, statewide annual savings potential is estimated to be 7,269 GWh or an estimated $1.1 billion statewide.

Consumer Appeal:

The technology can co-exist with existing systems or can be implemented as a new installation. For retrofits, ACCO-BEMS can connect to existing energy management systems, sensors, controllers, and meters to communicate with each in its native protocol. This allows for use of the technology with existing, installed equipment, avoiding the need for equipment replacement retrofits, or for the customer to learn a new system.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $552,488
EPIC Funds Encumbered: $2,500,000	**EPIC Funds Spent:** $1,408,017
Match Partner and Funding Split: Zero Net Energy (ZNE) Alliance: $25,000 (0.7 %) MelRok, LLC: $1,159,891 (31.5 %)	**Match Funding:** $1,184,891
Leverage Contributors:	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 8 out of 10 bidders	**Rank of Selected Applicant/ Bidder:** Phase 1 Group 2: Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The ACCO BEMS system is now installed at 10 of the buildings on the Pomona College campus. Next steps include commissioning the system, running fault detection, and further optimizing the building energy management system. Additional sensors and actuators have been installed and the project team has developed scripts to retrieve data from multiple sensors and BEMS points.

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Project Name:

High-Performance Cu-Plating for Heterojunction Silicon Cells, Based on Ultra-Low-Cost Printed Circuit Board (PCB) Technology (Stage II)

[EPC-16-035]

Recipient/Contractor:

Sunpreme, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/12/2017 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Standard front side metallization of industrial silicon solar cells uses silver paste for contact formation. Silver metal contained in the paste is an important cost driver in the manufacturing process. At the same time, the conductivity of printed and fired silver metallization is limited due to glass compounds and a porous structure. A metallization scheme based on all-copper plating proposed under this agreement has the potential to lower these costs while improving the overall efficiency of the photovoltaic cells.

Project Description:

This project develops a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing, reducing costs by up to 35%, and increasing cell efficiency by 15%.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project is developing a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing. This new process will lower electricity-related greenhouse gas (GHG) emissions and improve solar cells' efficiency.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1b, 1c, 2a, 3b, 4a

Lower Costs:

If successful, the production tools and processes developed under this agreement will allow for the manufacture of heterojunction silicon cells at 23.5% efficiency and 400W panels at a cost of 40¢ per watt.

Environmental Benefits:

Lower costs for photovoltaic panels will support California's transition to renewable sources of energy and result in reduced GHG emissions.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:

Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:

$730,620</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:

$2,430,000</td><td colspan="2">EPIC Funds Spent:

$1,711,084</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:

N/A</td><td colspan="2">Match Funding:

$0</td></tr>
<tr><td colspan="2">Leverage Contributors:

United States Department of Energy: $4,999,999
Sunpreme, Inc.: $4,540,310</td><td colspan="2">Leveraged Funds:

$9,540,309</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

43</td><td>Rank of Selected Applicant/ Bidder:

N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Patents issued to Sunpreme, Inc.:

1) "Low-cost solar cells and methods for fabricating low cost substrates for solar cells"</td></tr>
</table>

2) "Low-cost multi-junction solar cells and methods for their production" 3) "Low-cost solar cells and methods for their production" 4) "Low-cost multi-junction solar cells and methods for their production" Patent Application: "Flat tabbing solar panels".
Update: The project is well underway and the research team has established a manufacturing lane for copper patterning on silicon photovoltaic cells. Critical manufacturing tools (e.g., exposure, developer, stripper, etcher, and laminator) have been ordered and installed; commercial laminator tool has been modified; and dual-sided exposure tool for high-throughput wafer patterning has been developed. In the first quarter of 2018, the team fabricated cells with 24.03% efficiency and performed in-house reliability testing. Fifteen of these copper-metallized modules will be submitted for 3rd party testing. in June 2018, interim project results were presented at the World Conference on Photovoltaic Energy Conversion (WCPEC-7). In the next few months, the team will move to new lab facilities and continue process optimization and cell testing with the purpose to increase manufacturing throughput.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Thermoelectric Generator Application and Pilot Test in a Geothermal Field

[EPC-16-036]

Recipient/Contractor:

AltaRock Energy, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Growth of the geothermal industry has been held back by the need for large and costly power plants and large scale infrastructure to produce geothermal electricity economically. Typically, a geothermal project cannot produce electricity economically at a scale less than 5 MW. If smaller geothermal power plants could be economical, this would open up more opportunities to add geothermal power to the energy mix.

Project Description:

Thermoelectric Generator (TEG) technologies have the potential to produce geothermal electricity without as much infrastructure (turbines, steam piping, etc.) thus making small scale production and geothermal powered micro power grids both practicable and affordable. Small (<5 MW) geothermal projects could provide consumers with the same distributed power flexibility provided by solar and wind production with the additional benefit of being a more reliable baseload source of electricity. TEG technologies can also allow geothermal heat to provide balancing and grid support. This project is scaling up a TEG from the watt-level in the lab to a 20 kW unit for demonstration in a geothermal reservoir.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will develop a means to expand use of low temperature and stranded geothermal resources by making small scale production both practicable and affordable.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

APPENDIX B:
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Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 2a, 3b

Lower Costs:

Many smaller resources in remote areas are not currently able to be developed because it would not be economical to build a traditional geothermal power plant on such a small scale. Thermoelectric Generator technologies have the potential to help small scale geothermal power generation to be more cost effective by requiring less infrastructure and less complicated mechanical equipment.

Greater Reliability:

New baseload and flexible renewable generation technologies will improve the performance and reliability of the state's electrical grid system. Geothermal thermoelectric generators will expand use of low temperature and stranded geothermal resources in the state which have not traditionally been used to produce electricity. The technology can supply peaking power and balancing of intermittent renewable resources at much lower cost than batteries.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $420,699
EPIC Funds Encumbered: $1,280,000	**EPIC Funds Spent:** $143,349
Match Partner and Funding Split: Leland Stanford Junior University: $5,000 (0.4 %) AltaRock Energy, Inc.: $113,095 (8.1 %)	**Match Funding:** $118,095
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The test unit was completed and was tested in the lab. A series of modifications to the test unit to improve performance have been implemented and tested. An improved lab-scale unit with five layers of TEG modules is being built. The project is about 3-6 months behind schedule. They have taken longer than expected testing and redesigning the lab scale unit. In the next few months, the project should finish work on the lab scale unit (task 2) and start designing the 20 kW field scale unit (task 3).

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: The Amador Water Agency In-Conduit Hydropower Development Project (AWA Project) [EPC-16-037]	
Recipient/Contractor: Amador Water Agency	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 5/15/2017 to 12/31/2019
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.	
Issue: One of the oldest turbine technologies in California is the Pelton turbine, designed for high pressure conduit sites. There are an estimated 62 MW of installed Pelton turbines in California that are nearing the end of their in-service asset life and an estimated 8.2 MW of new small, in-conduit Pelton sites that remain undeveloped due to lack of efficiency and high costs. There is an immediate need to design, test, and demonstrate an improved and more efficient Pelton turbine runner in order to provide a viable retrofit solution for degrading sites and expand small hydropower deployment in new sites throughout California.	
Project Description: The goal of this project is to design, test, and demonstrate a 417 kW in-conduit Pelton turbine runner at an existing Pressure Reducing Station (PSR) site located in Ione, California. The project will demonstrate the ability to maximize the wasted energy captured at the station using an improved design of a higher-efficiency Pelton turbine runner specifically designed for small, in-conduit hydroelectric applications to contribute in the integration of in-conduit small hydropower into the existing state energy mix.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The system developed under this project will recover and maximize the capture of wasted energy in Pressure Reducing Station (PRS) commonly used by the water agencies and industry; improve the efficiency, performance and cost of the Pelton turbine technology to capture wasted energy and provide a viable retrofit solution for degrading sites; and expand small hydropower deployment.	

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 3a, 3b, 4a

Lower Costs:

Water agencies throughout the state will have an opportunity to generate additional revenue and/or offset ever-increasing electricity costs associated with treating, distributing and collecting water to help reduce costs to IOU ratepayers.

Greater Reliability:

The project will help achieve greater electricity reliability by supporting the generation of 72,000 MWh over a 50-year asset life of distributed, baseload renewable power using rotating equipment.

Environmental Benefits:

The ability to maximize and capture the wasted energy at the Pressure Reducing Station (PRS) to generate over 72,000 MWh of renewable power will offset 50,650 metric tons (MT) of CO2 equivalent over the 50-year useful asset life of the project.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $750,000		**EPIC Funds Spent:** $0	
Match Partner and Funding Split: NLine Energy, Inc.: $108,334 (5.8 %) Amador Water Agency: $1,006,666 (54.0 %)		**Match Funding:** $1,115,000	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 29 out of 32 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project kick-off meeting was held on July 14, 2017. The project has completed the design phase and has contracted with Gilkes to manufacture the turbine. Lead time for turbine is 36 weeks, with delivery expected in spring of 2019. AWA also procured a general contractor, Central Sierra Electric, to construct the project. All permits for the project have been secured and construction is underway. Project is projected to go on-line in September, 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Use of Indoor Rearing for Head-Starting Desert Tortoises

[EPC-16-038]

Recipient/Contractor:

The Regents of the University of California on behalf of the Davis campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/31/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

Rapid development of utility-scale solar energy electricity generation facilities in the desert southwest resulted in widespread loss of habitat for special status species, such as the Mojave Desert tortoise. Current law and implemented policies require that negative impacts to protected species be minimized or offset. Research is needed to evaluate the efficacy of head-starting as a mitigation tool for offsetting or minimizing impacts to the desert tortoise as well as aiding recovery of the species to streamline future permitting for renewable energy development.

Project Description:

The project conducts experimental releases of juvenile desert tortoises raised since 2011-2013 to evaluate the trade-offs of head-start duration on post-release survival of desert tortoises. The recipient is dividing hatchlings into two cohorts, raising half of them exclusively outdoors and the other half under a combination of indoor/outdoor rearing, releasing them as 2 year olds, and comparing their post-release survival. Data on the growth and survival of animals in this study provides guidance on the minimum duration of outdoor head-starting and whether indoor head-starting should be pursued in future head-starting programs for desert tortoises. Ultimately, the results of the study can inform the extent to which head-starting both indoors and outdoors is a viable solution for mitigating localized impacts to tortoise populations affected by development for solar energy production facilities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The research will be the first to evaluate the trade-offs in duration of head-starting on post-release survival in the eastern Mojave Desert where numerous solar production facilities have been recently constructed. Because longer head-start periods cost more, finding the optimal head-starting duration will help develop more cost-effective head-starting programs.

The research will also evaluate indoor-head-starting. If the increase in size also results in an increase in post-release survival compared to outdoor-reared animals, indoor head-starting could dramatically reduce the costs of rearing animals to releasable size and also increase production of head-starting facilities.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 3b, 4f, 4g

Lower Costs:

This project will result in the ratepayer benefit of lower costs by making head-start mitigation more cost-effective, reducing obstacles to future renewable energy deployment. It is important to determine the best practice methods for head-starting juvenile tortoises, including reducing time spent in captivity and increasing survival in the wild after release. This will minimize mitigation costs for renewable energy developers, thus reducing the cost of energy to ratepayers.

Environmental Benefits:

New scientific knowledge on minimum size required at release while improving survivorship, resource needs, and translocation practices will guide management in the future. Implementation of more effective mitigation practices may increase probability of de-listing the desert tortoise from the endangered species list in the future, making renewable energy development more feasible.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $77,924	
EPIC Funds Encumbered: $493,089		**EPIC Funds Spent:** $128,079	
Match Partner and Funding Split: The Regents of the University of California, Davis Campus: $61,119 (11.0 %)		**Match Funding:** $61,119	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 14 out of 14 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 2

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research team produced tortoise hatchlings in 2016 and 2017 and assigned them either to the indoor or outdoor experimental groups. The indoor group was raised indoors in their first year and then transitioned to outdoor pens for the second year of their head-starting. All captive tortoises were measured to track their growth rates in different treatments. In September 2018, the team released 78 juvenile tortoises and began post-release monitoring using radio telemetry. The project team is collaborating closely with a complementary project (EPC-16-053) in several areas, such as using a common technical advisory committee. They are also coordinating with US Fish and Wildlife Service and California Department of Fish and Wildlife to develop guidelines and management recommendations about this mitigation and recovery strategy.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

A Life Cycle Assessment of the Environmental and Human Health Impacts of Emerging Energy Storage Technology Deployment

[EPC-16-039]

Recipient/Contractor:

The Regents of the University of California, Irvine Campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/8/2017 to 8/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

Scalable stationary energy storage is a critical component for facilitating the increased integration of renewable resources and meeting California's energy goals. However, the information about environmental and human health impacts of the emerging large-scale energy storage technologies, especially flow batteries, is largely incomplete. A better understanding of the potential issues associated with the life cycle supply chain will enable these technologies to be scaled to the capacity levels necessary for providing widespread grid services without creating negative externalities.

Project Description:

This project investigates whether flow batteries are a viable option for providing grid energy storage at the large scale, either in place of or alongside lithium-ion battery technology. The researchers are examining a life cycle-based characterization of the environmental impacts and resource usage associated with three chemistries of flow batteries (Vanadium Redox (V2O5), Zinc-Bromide (ZnBr), and Iron-Sodium (FeNa)). Specifically, they are investigating materials use, energy use, and toxic waste outputs of the life cycle phases of each flow battery type, including materials extraction, manufacturing, use, and disposal or recycling as applicable.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project provides guidance for California policymakers and planning agencies for selecting emerging energy storage technologies that can facilitate the increased uptake of renewable resources and decarbonization of California's energy system in a way that minimizes the externalities of environmental and human health impacts. This study is a first of its kind for flow battery technology and provides the knowledge base and understanding

<table>
<tr><td colspan="4">necessary to allow flow batteries to be deployed in a manner which alleviates or circumvents potential obstacles related to environmental and human health.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Smart grid: R.08-12-009 [closed] Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 3e, 4b, 4c, 4d, 4e, 4f, 5d, 5e
Environmental Benefits:
This project will provide information that can be used to avoid environmental and safety issues that could result from the scale up of energy storage technologies.

Public Health:
The project will characterize the human health impacts from different grid-scale energy storage technologies. If successful, the project will help avoid potential health and safety issues that could hinder the scale up of new energy storage technologies.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Distribution</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$98,142</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$600,000</td><td colspan="2">EPIC Funds Spent:
$155,924</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
The Regents of the University of California, Irvine: $186,219 (23.7 %)</td><td colspan="2">Match Funding:
$186,219</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
14 out of 14 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 5: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research team toured three flow battery manufacturing facilities (ESS, UET, Primus Power) and obtained inventory data for materials and energy use for all of them. In consultation with other literature sources the team developed a database for material use, energy use, waste, emissions, and costs associated with three different flow battery chemistries. Researchers also selected and evaluated indicators capturing the environmental impact of flow batteries and used preliminary results for the environmental impacts of the flow battery life cycle for initial comparison with that of a lithium-ion battery. In early 2019, the research team will begin to assess the maximum capacity deployment threshold for the three flow battery chemistries in order to identify the tipping point for net environmental benefits from their application.

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Project Name:

Assessing Cooling Tower PM2.5 and PM10 Emissions using Advanced Instrumentation, Plume Transects, and Plume Modeling

[EPC-16-040]

Recipient/Contractor:

The Regents of the University of California, Davis Campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/15/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

The majority of California power plants are located in areas designated as nonattainment for particulate matter (PM10). The increasing demands and decreasing supply of naturally available freshwater throughout California result in state policies discouraging the use of freshwater for the purpose of heat rejection in cooling towers for recently approved thermal power generation plants. Degraded waters contain higher concentrations of total dissolved solids (TDS) and thus higher calculated emissions that require the purchase of costly PM offsets. These increases in emissions are a significant burden for power plant developers and may discourage the use of degraded water sources for cooling.

Project Description:

This project measures PM2.5 and PM10 across the spray drift plume from two power plant cooling towers that use fresh water and brackish water. These measurements are used to develop and validate a model of power plant PM2.5 and PM10 emissions. The end result is a model that power plant operators can use to minimize the PM2.5 and PM10 effects of brackish water use in cooling towers.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The research team is using plume measurements from fresh and brackish water cooling towers to develop a model of the droplet and particle size distribution changes in cooling tower plumes as a function of cooling water composition, meteorological conditions, and cooling tower operating parameters. The model will be based on first principles of chemistry and physics and validated using the measurement data. The model enables the use of

brackish water instead of expensive fresh water, leading to decreased costs for electric utilities and ratepayers and freeing up more fresh water for use in homes, industry, and agriculture in California.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 2a, 3a, 4b, 4c

Lower Costs:

This project decreases power plant operating costs by switching from fresh water to brackish water, saving money to the operators of the facilities, since brackish water is less expensive than fresh water.

Environmental Benefits:

This project enables the use of brackish water in cooling towers in California, conserving valuable fresh water resources.

Public Health:

The modeling work focuses on decreasing the concentration of PM2.5 and PM10 downwind of power plant cooling towers when brackish water is used for cooling, thereby improving air quality in these locations.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $108,004	
EPIC Funds Encumbered: $700,000		**EPIC Funds Spent:** $47,077	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 14 out of 14 bidders	**Rank of Selected Applicant/ Bidder:** Group 4: Ranked # 1

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research team finalized the design of the instrument package for PM monitoring from cooling towers. The research team also identified two power plants for testing. The instrument package was installed on the cooling tower for one of the power plants in December 2018. Since both power plants will have a similar amount of total dissolved solids (TDS) in the circulating water, the team is working on identifying additional power plants with different TDS levels to test the different behaviors.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Benefits and Challenges in Deployment of Low GWP A3 Refrigerants in Residential and Commercial Cooling Equipment

[EPC-16-041]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/8/2017 to 12/16/2019

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

California has an aggressive target to phase down high global warming potential refrigerant greenhouse gas emissions by 40 percent by 2030 (SB 1383) from 2013 levels. This includes proposed regulations to ban refrigerants with a global warming potential (GWP) greater than 150 in non-residential refrigeration by 2022, and refrigerants with a GWP greater than 750 in commercial and residential air-conditioning by 2023. A3 refrigerants are a very low-GWP alternative, but in order to utilize them, some redesign and standards development are needed, as well as more well-developed installation, operation, and maintenance practices.

Project Description:

This project will develop test procedures and conduct testing for alternative refrigerants to assess flammability and to characterize energy savings. The recipient will also develop a favorability index of end-use market segments and equipment types based on potential GHG savings and commercial adoption feasibility.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is evaluating alternative, low global warming potential (GWP) refrigerants that will also result in increased energy efficiency of cooling equipment. This project will identify current barriers and technical issues, and assess the potential for an expanded set of products which could use low GWP A3 refrigerants. The project will incentivize manufacturers to develop product prototypes that could be tested at the recipient's facility. This can help equipment manufacturers and vendors with product development and lead to an increase in the supply of equipment with much lower lifetime GHG emissions. By transitioning to refrigerants with lower GWP refrigerants, the state will see fewer GHG emissions from commercial and residential buildings over the next 10 - 30 years.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 4a

Environmental Benefits:

Transitioning to lower-GWP refrigerants for all product types by 2030 and 2050 could reduce refrigerant emissions and greenhouse gas emissions down to an estimated 5 and 6 Mt CO2e, for the refrigeration and air conditioning sector, respectively.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $221,625
EPIC Funds Encumbered: $500,000	**EPIC Funds Spent:** $155,800
Match Partner and Funding Split: Institute for Governance & Sustainable Development: $500,000 (50.0 %)	**Match Funding:** $500,000
Leverage Contributors:	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 14 out of 14 bidders	**Rank of Selected Applicant/ Bidder:** Group 7: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team has completed the literature review of alternative refrigerants for residential and commercial buildings. The recipient is preparing test plans to analyze cost savings, energy savings, GHG reductions, and efficacy of the A3 alternatives. The recipient expects to start testing equipment in 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Low-Cost High-Reliability Thermoelectrics for Waste Heat Conversion

[EPC-16-042]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/15/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Current commercially available thermoelectric materials can only operate reliably up to 250 degrees C in temperature and has a low efficiency (5 percent). Few materials that have been evaluated at higher temperature suffer from reliability issues due to use of lead and oxidation and sublimation problems. Silicon is abundant and stable at high temperature but although thermoelectric device made from Si holds much promise, bulk Si has low figure-of-merit. One established strategy for increasing figure-of-merit is to employ nanostructuring to decrease thermal conductivity. Silicon nanowires represent a new, highly scalable technology that overcomes the limitations of previous efforts.

Project Description:

This project is developing a cost-effective mid- to high-temperature range (400-800C) p-type thermoelectric material for waste heat recovery using silicon nanowire arrays. The intent is to surpass technologies implementing an organic Rankine cycle or similar processes by having low parasitic losses, compact, and able to be modularized for a broad scale of distributed applications. To achieve the goal, the project will advance the state of the art in nanowire characterization; demonstrate an optimized process for the production of Si-nw arrays and a process to produce a freestanding array of aligned nanowires; characterize the thermoelectric and mechanical properties of these arrays and single Si-nw; optimize the fabrication of Si-nw arrays; and integrate into devices capable of heat-to-power conversion. The results of device performance will be used to evaluate the techno-economic impacts of this technology. Taken together, the project will move silicon nanowire technology's Technology Readiness Level (TRL) from 2 to a prototype technology demonstration in a relevant environment (TRL5).

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How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will address principal barriers to the widespread application of current thermoelectric materials by providing a low-cost, reliable, affordable and mass-producible technology that can be ubiquitously applied to convert high-temperature heat that is currently wasted at the production and retail levels in California.

CPUC Proceedings addressing issues related to this EPIC project:

Applicable Metrics: CPUC Metrics- 1h, 3h, 4a

Greater Reliability:

This project will create a cost-effective Thermoelectric Waste Heat Recovery system that will reduce energy use in the industrial sector, thus benefitting California ratepayers by increasing electrical reliability and lowering electricity costs.

Economic Development:

The total waste heat potential in California is 763 megawatts. Assuming a system cost of $1.5/watt and a 10 percent penetration, the estimated levelized cost of electricity is $0.015/kWh. Considering the value of renewable electricity generated and a 20-year asset life, the net present value at 10% penetration is estimated at $1.2 billion, with a payback period of just over one year.

Energy Security:

Based on the assessment sponsored by Oak Ridge National Laboratory, the total potential net savings in electricity use per year from harvesting waste heat is about 0.022 quads for California. This is based on one-third of the theoretical maximum efficiency limit for heat engines (also known as the Carnot efficiency). Assuming an average source temperature of 800 F and a 10 percent efficiency for the silicone nanowire thermoelectric conversion system, the total potential for this technology is approximately 0.011 quads.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $440,167
EPIC Funds Encumbered: $2,000,000	**EPIC Funds Spent:** $0
Match Partner and Funding Split: The Board of Trustees of the Leland Stanford Junior University: $516,502 (20.5 %)	**Match Funding:** $516,502

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Since the project kicked off in September 2017, Alphabet Energy dropped out of the project forcing LBNL to seek a substitute. Stanford University has stepped forward as an alternate subcontractor responsible for manufacturing thermoelectric nanofibers. An amendment to add Stanford as a major subcontractor and extend the project term to recover lost time is currently in process.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Cost-Effective and Climate Resilient In-Conduit Hydropower and Civil Works Innovation

[EPC-16-043]

Recipient/Contractor:

Natel Energy

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/1/2017 to 3/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

A 2006 report issued by the California Energy Commission estimated approximately 120 MW of low-head small hydropower available in irrigation structures in California. Additionally, hydropower generation is controlled by the irrigation district's delivery schedules and generally suffers outside the irrigation season, greatly affecting the economics of hydropower for many of these opportunities. Innovative strategies to reduce costs through effective equipment or site design, standardization, or increasing the water flows can bring many projects into an attractive return on investment.

Project Description:

This project aims to scale in-canal hydropower retrofits by lowering project footprint and civil works costs. As most drop structures in irrigation canals have a consistent design, the goal is to design and implement a modular powerhouse and standard plant design that can be replicated across irrigation drops in California. Using a simpler and more easily scalable design will support the installation of the system to scale across the low-head sites identified across California with in-canal potential.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Greater reliability will be achieved by enabling greater penetration at significant total megawatts of new, distributed baseload renewable energy with predictable generation profiles. The project will also significantly reduce the capital cost of installing small hydropower in existing irrigation drop structures by reducing the cost of construction and civil works by an estimated 50 percent when compared with installing custom designed works and equipment for each site.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]

Applicable Metrics: CPUC Metrics- 1a, 1b

Lower Costs:

The over canal design being pursued in this project is estimated to lower the LCOE of low-head hydropower at irrigation system drop structures to $55/MW by 2019, unlocking approximately 150 MW of baseload renewable capacity in the state.

Greater Reliability:

The design enables simplified maintenance by minimizing part counts and directing machine wear to specific, easily-replaced parts. The design leads to straightforward and streamlined operation, minimizing scheduled maintenance and prolonging product operating life.

Increase Safety:

Natel's California project pipeline is focused on low-head, low-pressure in-conduit - or in-canal - hydropower projects, auxiliary benefits from which include improving safety. At the bottom of a conventional high or low-head dam that utilizes a stream reach, a hydraulic jump zone similar to an undertow at a beach often develops, which increases drowning risks for project area communities, particularly children. Nate's design incorporates a draft chamber that is comparable to an enclosed stilling basin where any remaining force in the water is diffused and allows water to leave the chamber depowered, further reducing associated attractant flow risks for both humans and animals.

Economic Development:

Distributed hydro is inherently local and thus contributes directly to local construction jobs and improving the financial position of local institutions like irrigation districts. Distributed hydro projects are often integrated into independent grids, the maintenance of which requires skilled technicians and thus also leads to job creation.

Public Health:

Although the projects associated with this grant will interconnect to PG&E distribution systems, future project have the potential for distributed hydro as an off-grid solution for remote communities. In remote locations where diesel generators are the primary or sole source of electricity, distributed hydro can reduce the usage of diesel generators and help improve air quality at a cost that is often well below that of diesel generation.

Energy Security:

APPENDIX B:
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Energy security is enhanced by powering an otherwise unutilized hydrological resource in the form of an existing hydrological structure, reducing both present and future dependences on imported fuel sources. Distributed generating assets can also help reduce the impacts from natural (and man-made) disasters, as they complement and increase the overall resilience of the electricity grid.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $954,715	**EPIC Funds Spent:** $52,742
Match Partner and Funding Split: Natel Energy: $954,715 (50.0 %	**Match Funding:** $954,715
Leverage Contributors:	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 29 out of 32 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kicked-off in July 2017. The project team has selected two sites for demonstration: Alder Drop in Yolo County, and Murphys Afterbay in Calaveras County. Interconnection applications for each project have been filed with PG&E and are under review. Natel currently seeking bids of EPC firms to manage construction, which is expected to take place in the second quarter of 2019. Natel also briefly reviewed a third possible demonstration site in the Banta-Carbona Irrigation District (San Joaquin County), but quickly determined the flows were inadequate to support a project. The Commission project manager has scheduled a critical project review to review project progress in February, 2019.

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Project Name:

Hyper Efficient Pump Motor Unit with Fully Integrated Permanent Magnet Motor and Motor Controls with Combined Liquid Cooling

[EPC-16-044]

Recipient/Contractor:

Terzo Power Systems, LLC.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/1/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

The greatest barrier to the adoption of current energy saving technology in hydraulic power systems is high cost and long break-even period. This barrier has not been addressed due to the research and development costs associated with integrating the newest, highest efficiency technology.

Project Description:

This project is developing an economical and efficient configuration for large scale integration and adoption of highly efficient liquid cooled permanent magnet motors, and fully integrated, liquid cooled motor controls. The goal is to use these technologies in the development of a smart pump motor unit that can quickly be commercialized and adopted statewide.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project could reduce the operating cost for hydraulic power systems by integrating an efficient permanent magnet motor, efficient motor controller, and a combined liquid cooling loop. Hydraulic power systems are found in nearly all industrial facilities.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h
Lower Costs:
Project will increase efficiency of hydraulic pump systems by up to 80% thereby reduce energy costs by an estimated $18,974,250 per year assuming 100% market penetration by 2025.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$99,350</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,311,050</td><td colspan="2">EPIC Funds Spent:
$1,156,335</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Terzo Power Systems, LLC.: $19,589 (0.8 %)
Ansync Labs, Inc.: $126,100 (5.1 %)</td><td colspan="2">Match Funding:
$145,689</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Phase 1 Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The recipient has completed reports on the Insulated-Gate Bipolar Transistor (IGBT) and Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) efficiency. Other tasks completed include testing with the hydraulic manifold and finalized machining work for aluminum housing for eventual thermal, hydraulic and electrical testing.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Development of New Technologies for Agricultural Loads to Participate in Renewables Integration, RTP Programs, and/or New Time of Use Rates

[EPC-16-045]

Recipient/Contractor:

Polaris Energy Services Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/1/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Participation in demand response (DR) programs by agricultural customers using irrigation pumps is largely limited to emergency/reliability programs. The potential for irrigation pumps to be managed for more frequent/regular response to dynamic DR programs appears high, but challenges remain that require additional research and demonstration. Research focusing on resolving these challenges and developing effective, replicable strategies--particularly coordinating control systems with crop and operational needs such as sand removal, reservoir charging, and crop response to variation in irrigation schedules--is needed.

Project Description:

This project will result in the development of a smart irrigation control system that improves and expands on current remote irrigation pump switching technology. The technologies developed will provide growers with the ability to automate their preferred load control strategies in response to new time-of-use electricity rates. Beyond that basic capability, the systems facilitate automated response to utility and system operator demand response signals, enabling participation in current and future demand response and reliability programs. The system is being deployed and tested on multiple farms and multiple crop types in PG&E service territory in the Fresno area.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

For many electrical utilities, agriculture is a significant component of their peak load. Collectively there are between 160,000 and 170,000 irrigation pumps in the Central Valley. This project addresses the direct electricity cost of irrigation for agricultural customers and the indirect cost to all electricity ratepayers of procuring sufficient resources to meet marginal peak demand, integrating variable renewable energy generation, and building sufficient

<table>
<tr><td colspan="4">infrastructure to support agricultural pumping load peaks. The project goal is to develop control systems and operational strategies that can adapt to different rate designs--including dynamic and DR-program tariffs--by optimizing pumping loads across large numbers of irrigation pumps to me</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Smart grid: R.08-12-009 [closed] Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1g, 1h, 3f
Lower Costs:
The technology could facilitate effective response to time of use rates and facilitate participation in demand response programs through the shifting of agricultural irrigation pumping to lower cost time or in response to program incentives, lowering customer costs as well as enabling effective implementation of programs/tariffs designed to reduce system costs and meet state policy goals.

Greater Reliability:
The technology could facilitate participation in demand response programs through the shifting of agricultural irrigation pumping to periods of surplus renewable energy, which improves system reliability by matching load to available supply and shedding loads during grid emergencies.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$0</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,884,912</td><td colspan="2">EPIC Funds Spent:
$1,029,415</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Polaris Energy Services Inc.: $649,485 (18.4 %)</td><td colspan="2">Match Funding:
$649,485</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Phase 1 Group 2: Ranked # 2</td></tr>
</table>

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. Michael Hardy, Control Dynamics, and Polaris developed the core hardware and associated firmware communications needed to remote control irrigation pumps remotely. The recipient intends to use this platform and methods to develop the new controller.
Update: The project is on track. The project team has set up the irrigation control systems, and iteratively testing and improving the software control system and dispatch mechanisms with the active involvement of the growers to minimize disruption to the farming operation, avoid negatively impacting crop yields, minimize electricity costs, conserve water, and maximize flexibility in anticipation of greater opportunities for demand response participation in anticipation of expanded DR participation offerings from the utilities. The team is exploring the opportunity to incorporate a transactive component to their load management platform and is working with PG&E and SCE to develop an experimental tariff that would allow customers to increase participation and evaluate the application of real-time energy pricing to agricultural operations. Staff visited the site on December 5, 2018.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Pilot Testing of Isothermal Compression

[EPC-16-046]

Recipient/Contractor:

Institute of Gas Technology dba Gas Technology Institute

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/12/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Currently, gas compression is limited by the thermodynamics of an adiabatic process which causes the gas being compressed to heat up during compression, making it harder to compress. This heating process can also lead to high operating temperatures which can increase the friction and wear of moving components. It is estimated that as much as 90% of the mechanical work input into an air compressor results in a loss of energy compared to the useful work output of the compressed air that is used to power an industrial process. Heat of compression is the biggest driver of this energy loss.

Project Description:

Gas Technology Institute (GTI) and Carnot Compression LLC (Carnot) are developing and field testing a novel, near isothermal air compressor which will enable improved efficiency, maintenance and reliability. The unit will be tested at an industrial facility in southern California. This project hopes to reduce the energy consumption in industrial, water, agricultural, and commercial applications that require compression of air and other gases. This project demonstrates a more efficient compressor that will use less electricity to meet the same performance metrics of existing air and gas compressors. If successful, this project could improve the energy efficiency of compressed air/gas systems which are prevalent in all industrial processing facilities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This near isothermal compressor, or Carnot Compressor, solves the heat of compression problem by using a working liquid to compress a gas, while actively removing the heat of compression throughout the compression process. By removing the heat throughout the compression step, the energy required to compress air from near atmospheric pressure to ~100 psig can be reduced by up to 50% compared to commercial air compressors, such as piston, screw, and scroll designs. These energy savings are expected to significantly improve the efficiency of industrial air applications.

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs:

The technology has the potential to reduce energy consumption from air and gas compressors by up to 50%. Once commercialized, the isothermal compression process will deliver significant energy efficiency gains across a broad spectrum of compression applications.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$628,022
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$2,570,946	$1,014,316
Match Partner and Funding Split:	**Match Funding:**
Carnot Compression LLC: $238,700 (8.5 %)	$238,700
Leverage Contributors:	**Leveraged Funds:**
N/A	$0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	phase 1: 27 out of 28 bidders	Phase 1 Group 1: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

The project team finished the preliminary design of the isothermal compressor system and the design was discussed with team members during the first TAC meeting on October 10, 2018. The project is shifting focus towards finalizing the detailed design drawings and engaging with potential manufacturing firms for fabrication and assembly work of the prototype system, which is expected to be completed and operational by end of Q3 2019.

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Project Name:

California Biopower Impact Project

[EPC-16-047]

Recipient/Contractor:

Humboldt State University Sponsored Programs Foundation

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/10/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

Biomass is a potentially attractive energy resource that supports California's climate goals. However, there are significant gaps in existing life cycle assessment frameworks and methodologies regarding the climate impact associated with greenhouse gas (GHG) emissions from biomass use for electricity generation. Furthermore, biomass residue extraction has complex environmental and ecosystem impacts (positive and negative), some of which have not been well integrated into current life cycle assessments. Finally, there are significant market barriers to biomass mobilization in the forestry sector, that can render well intentioned policies ineffective if not appropriately addressed.

Project Description:

This project develops an attributional life cycle assessment framework for various biomass-to-electricity supply chain and end-use scenarios that are specific to California. The research effort quantifies on a fine geospatial scale the amount of technically recoverable forest and agricultural biomass residue material in California, and it considers future impact projections from different climate change scenarios and fire risk probabilities under various harvest and land management scenarios. Based on the estimates, researchers are developing a detailed life cycle inventory - disaggregated by parcel, supply chain, and end-use characteristics. Results will support development of the California Residual Biomass-to-energy Carbon Accounting Tool (CARB-CAT) that will be made available to public and could inform policy decisions on the role of biomass residues in California's energy portfolio.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This research project develops a rigorous California-specific lifecycle emissions accounting framework for evaluation of various forest biomass residue mobilization scenarios, quantification of key potential environmental and climate impacts associated with biomass

residue mobilization and conversion to electricity, and identification of potential pathways for offsetting biomass residue mobilization costs. The framework and Carbon Accounting Tool (CaRBCAT) will provide California policymakers with an evidence-based, spatially disaggregated, and probabilistic analysis to aid in creating policies aimed at managing the environmental performance of bioenergy systems. Ultimately, the results from this project will provide information on the topic of carbon neutrality of residual biomass-to-energy production

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 3g, 4a, 4b

Lower Costs:

Lower costs may be realized if the ecosystem service payments coupled with value estimates of potential carbon abatement from biopower exceed the internalized average or marginal wholesale cost per MWh of displaced generation.

Greater Reliability:

Increased electricity reliability will be brought about by policies that encourage grid resilience through distributed generation facilities powered by biomass that would diversify California's mix of energy resources.

Environmental Benefits:

The lifecycle assessment of biomass use for electricity generation will consider specific harvest practices, feedstock collection and handling practices, post-harvest treatments (briquetting, torrefaction, pelletization, etc.), feedstock management pathways, and conversion technologies, and it will provide information on the GHG implications from altered wildfire risk and severity and from altered long-term soil nutrient balance.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $247,784
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $239,041
Match Partner and Funding Split: Sierra Institute for Community and Environment: $78,000 (6.9 %) Humboldt State University Sponsored Programs Foundation: $53,575 (4.7 %)	**Match Funding:** $131,575

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
14 out of 14 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The research team has conducted a net potential recoverable forest and agricultural residue assessment and compiled a spatially explicit database of these materials. The team has also developed a residual biomass-to-energy life cycle emissions accounting framework that considers various supply-chain and end-use scenarios for California. The team is publishing a beta version of an interactive accounting tool for GHG emissions from woody biomass converted to electricity in December 2018.

In early 2019, the research team will continue working on the wildfire risk impact assessment, begin characterization of secondary environmental and climate impacts from woody biomass, and identify pathways for cost offsetting for biomass use.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Development and Testing of an Energy Efficient Ultra-Low Charge Ammonia Refrigeration System in a Food Processing Plant

[EPC-16-048]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/5/2017 to 12/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Most ammonia-based cooling systems in use today require large amounts of ammonia and are prone to leakage from the mechanical shaft seal between the motor and compressor, and require special handling. Additionally, most ammonia systems used today are either water cooled or evaporative cooled, which require water, a very limited and precious resource in California due to recent droughts.

Project Description:

This project is pilot testing and demonstrating an air-cooled, low-charge ammonia refrigerant-based, integrated package closed cooling system for an industrial food processing application. The project is demonstrating the effectiveness of a water-saving innovation with the use of a micro-channel, air-cooled condenser. The project is demonstrating the expected energy savings of 20% compared to a chiller using hydrofluorocarbon (HFC) refrigerant for similar end use at the same site. This system eliminates the need for water for cooling. The entire system can be prepackaged and factory charged, and brought to site as an integrated package which simplifies field installation and makes it cost effective.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

An air cooled, low-charge, ammonia refrigerant based integrated closed-packaged system with semi-hermetic motor/compressor seal that eliminates the mechanical seal between the compressor and the motor is not available in the U.S market today. As this is a packaged product, this breakthrough will make it much easier for customers to implement this new technology and reap the energy and water savings benefits from it.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a
Lower Costs:
Expected energy savings of 20% compared to a chiller using hydrofluorocarbon (HFC) refrigerant for similar end use at the same site. This system eliminates the need for water for cooling, which further adds to on-site cost savings.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$804,238</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,406,054</td><td colspan="2">EPIC Funds Spent:
$304,488</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
TAKARA SAKE USA: $305,000 (10.1 %)
Electric Power Research Institute, Inc.: $300,000 (10.0 %)</td><td colspan="2">Match Funding:
$605,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Phase 1 Group 1: Ranked # 5</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

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Update:

The low-charge, packaged ammonia chiller installation was completed in February 2018 and is operating normally as confirmed by monitoring and verification data. Preliminary M&V results show that the ammonia chiller is 37.6 % and 48.8% more efficient than the R-507A chiller and the chiller and the pump (as a whole system), respectively. The Coefficient of Performance of the ammonia chiller is 4.87.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Ultra-High Power Density Roadway Piezoelectric Energy Harvesting System

[EPC-16-049]

Recipient/Contractor:

University of California - Merced

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Heavy traffic of ground vehicles and pedestrians on highways, streets and sidewalks provides considerable mechanical energy. There is an untapped opportunity to harvest the mechanical energy with under-pavement piezoelectric generators to exploit the large generation potential from traffic on the nation's highways and in major cities. This project aims to create a piezoelectric energy harvesting system with ultra-high density and efficiency.

Project Description:

This project leverages a multidisciplinary system approach to investigate the energy recovery potential of dual-mode piezoelectric generators to create roadway piezoelectric energy harvesting systems with ultra-high power density and efficiency. The goal is to design and test a piezoelectric roadway energy harvesting system, consisting of multi-layer stack generators and power electronics, to capture over 50% of the compression mechanical energy as electricity from passing vehicles. This project will demonstrate electric power generation, in the laboratory and on a 95 feet x 12 feet section of a road at the UC Merced campus, and will determine feasibility for future large-scale demonstrations on highways and streets with piezoelectric under-pavement.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project advances a piezoelectric energy harvesting system with ultra-high density and efficiency. Using an award-winning piezoelectric technology with unique dual-mode and multi-layer generator design and under-pavement installation strategy for smooth drive of passing vehicles and pedestrians, this project will help the ratepayers in California by reducing cost of electricity and reducing emissions related to power generation.

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CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1e, 3h, 4a

Lower Costs:

At commercial scale, electric power density and cost are estimated to be 333 watts per square foot and $9,010/kW respectively. The levelized cost of electricity is estimated to be less than $0.20/kWh.

Environmental Benefits:

This project will reduce approximately 40 metric tonnes of CO2 equivalent. By retrofitting 1 percent of useable roadways, the environmental benefits will include reduction of CO2 emissions by more than 100 kilotons per year.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $310,100
EPIC Funds Encumbered: $1,270,000	**EPIC Funds Spent:** $0
Match Partner and Funding Split: N/A	**Match Funding:** $0
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method:	Funding Mechanism:	No. of Initial Passing Applicants/ Bidders:	Rank of Selected Applicant/ Bidder:
Competitive	Grant	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	Group 2: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Terms and Conditions.
Update: The project has completed design and fabrication of a batch of multi-layer piezoelectric generators and metal frame, and has conducted laboratory evaluation of the prototype. The prototype design was revised and improved, resulting in promising relationship between the loading and displacement of the piezoelectric unit. An order to purchase 200 piezoelectric generator towers was issued.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Scaling Reliable, Next-Generation Perovskite Solar Cell Modules

[EPC-16-050]

Recipient/Contractor:

The Regents of the University of California, on behalf of the San Diego campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

There is need to deploy renewable energy to meet additional energy demand as well as replace fossil energy. Perovskite technology holds promise in dramatically reducing the cost of solar cell technology compared to silicon and thin-film solar cells, because these cells can be fabricated at low-temperature around 100°C. However, there is a need to address perovskite cell efficiency degradation, which may occur within hours of fabrication.

Project Description:

Recent advances have pushed the solar conversion efficiency, making perovskites one of the most efficient solar technologies in existence. This project will use a scalable large-area manufacturing approach for fabrication of the perovskite solar absorber, the solar cell's transport and contact layers, and the encapsulation of the solar cell modules. The project will also include bifacial module design, where light enters from both front and back.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Currently, encapsulated perovskite cells degrade in several hundred hours even in controlled low-oxygen and low-humidity conditions. This project integrates materials innovations developed to date at UC San Diego in the perovskite absorber layer, the solar cell's contact layers, and the encapsulation of the module to make breakthrough advances in perovskite solar cell reliability and scaling. Combining these materials together in a module assembly with glass on top and bottom slows degradation by a factor of 1,000. In addition, the bifacial design of module boosts its efficiency.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4a

Lower Costs:

This project aims to increase annual production of solar cells by reducing absorber and cell manufacturing costs relative to commercialized Si and thin-film technologies.

Greater Reliability:

Integrating bifacial glass-glass modules should result in more energy production over time from solar cells and orders of magnitude improvement in perovskite solar cell durability, achieving at least 10 year operational lifetimes.

Economic Development:

Over 75,000 people were employed in California's solar industry, installing over 3 GW of solar in 2015. The number of solar jobs would jump when next-generation perovskite modules are introduced at half the cost of silicon modules, resulting in vastly expanded demand.

Environmental Benefits:

A 1% market penetration on IOU-territory rooftops will produce 1.36 TW-hr/yr of renewable energy. The value of the renewable energy produced annually is $235.8 million with 4.48 million metric tonnes CO2e avoided.

Public Health:

In addition to avoiding greenhouse gas emissions, solar energy generation does not produce toxic air emissions including mercury, NOx, SOx and particulate matter that produce smog and are detrimental to health. A 1 GW deployment of the perovskite module technology would reduce emissions of NOx by at least 400 tons annually by displacing burning of natural gas.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$184,540
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,450,000	$126,826

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:
The Regents of the University of California, San Diego: $146,050 (9.2 %)</td><td colspan="2">Match Funding:
$146,050</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project team successfully transferred graphene atop perovskite layers, developed new electron transport layers, and is improving cell process by characterization and new absorber layer chemistry. The project team is now comparing the unencapsulated perovskite against the graphene barrier layer encapsulated perovskite cells. The project is growing crystals by using an electro-deposition approach.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Increased Energy Efficiency via Programmable Irrigation and Fertigation

[EPC-16-051]

Recipient/Contractor:

PowWow Energy, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/12/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Current energy efficiency programs do not address the complexity of farming, and in some cases conflict with each other at the farm. The lack of automation also slows the adoption of new irrigation and fertilization practices. An integrated approach to test cutting-edge technologies and demonstrating new irrigation strategies is necessary to provide additional energy and water savings without affecting crop yields. Geo-spatial and automated systems developed for the 3 commodity crops in the Midwest do not address the specific needs of California agriculture that grows over 350 specialty crops and produces more than 50% of the fruits, nuts and vegetables in the country.

Project Description:

PowWow Energy, in collaboration with WiseConn Engineering, West Hills College Coalinga (WHCC) and UC Santa Barbara (UCSB), are developing an automated, programmable irrigation management system that integrates cutting-edge technologies to increase the energy efficiency of irrigation (defined as using less energy to achieve the same level of crop production). Pilot-scale tests of the integrated technology platform will be conducted at two sites on commercial farms located in disadvantaged communities: an almond orchard near Delano (AgWise Enterprises, SCE territory) and a field with a rotation of row crops (tomato, garlic, etc.) near Huron (Woolf Farming and Processing, PG&E territory).

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project integrates three new strategies for water and energy efficiency on farms (continuous pump testing with automated remote pump control, programmable irrigation for specific soil types and plant varieties, and management of water and fertility) with PowWow's software. If successful, this project could help individual farms realize energy, water and cost savings without affecting crop yield or quality.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Water-Energy Nexus: R.13-12-011 [Closed] Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1h, 4a, 4c
Lower Costs:
The project could lower energy and water costs by an estimated 25% annually while achieving optimum efficiency at each farm.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$341,285</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,992,660</td><td colspan="2">EPIC Funds Spent:
$896,978</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
TBD Professional Services: $10,000 (0.3 %)
West Hills College Coalinga: $56,028 (1.7 %)
Environmental Studies Program & Bren School of Environmental Science & Management - UC Santa Barbara: $19,870 (0.6 %)
WiseConn Engineering: $7,000 (0.2 %)
Aduro Accounting & Consulting, LLC: $42,000 (1.3 %)
Mamala Research, LLC: $3,000 (0.1 %)
PowWow Energy, Inc.: $212,649 (6.4 %)</td><td colspan="2">Match Funding:
$350,547</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 27 out of 28 bidders</td><td>Rank of Selected Applicant/ Bidder:
Phase 1 Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project team is finalizing the summary reports for pilot sites and fieldwork for the 2018 experiments. The project team is working with University of California Santa Barbara to tabulate the results from the experiments to calculate savings in energy and water use efficiency as part of the measurement and verification report. Report is expected by early January 2019.

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Project Name:

Force Multiplier Actuated Piezoelectric Energy Harvester for Roadway Energy Recovery [EPC-16-052]

Recipient/Contractor:

Pyro-E, LLC

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Congested roadways present an opportunity for improving transportation and mobility. But the cost of new construction is expensive. An alternative approach is to leverage technology to make existing roads more energy sustainable and adaptable to real-time conditions. Regenerative devices, such as piezoelectric, have the ability to harvest energy from deflection, vibrations and applied mechanical stresses from overpassing vehicles.

Project Description:

The project develops, designs and installs a multitude of pavement-embedded devices to demonstrate energy harvesting from overpassing motor vehicles on the road in smart pavement covering 36 feet x 6 feet. The system consists of materials that exhibit the piezoelectric effect and result in generating an electric charge.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project demonstrates and assesses the potential of Regenerative Pavement technology, a roadway-embedded energy harvester that uses the untapped energy of car movements. The hardware devices developed using smart materials harvest energy from pavement deflections and vibrations under normal driving conditions. Simultaneously, energy performance data is collected to determine the technology's potential for widescale adoption in roadways and other surfaces.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013

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Applicable Metrics: CPUC Metrics- 1e, 2a

Economic Development:

This project is expected to displace grid electricity with reduced rates, and will displace 9,550 kWh/year of electricity. By retrofitting 1% of useable roadways (about 10% of total California roads), resulting in about 70,000 homes serviceable during peak traffic hours and about 500 GWh/year of peak load reduction and demand response.

Environmental Benefits:

The project will generate electricity by piezoelectric effect of overpassing vehicles on the road and will displace 3.65 kg/year of CO2. By retrofitting 1% of useable roadways, the environmental benefits will be significant including reducing about 210 kilotons of CO2 emissions and displacing 250 million gallons of fresh water from cooling gas power plants every year.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $234,596
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $225,981
Match Partner and Funding Split: Pyro-E, LLC: $100,007 (9.1 %)	**Match Funding:** $100,007
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

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Update:

The project team completed basic design for the vibrational energy harvester, with a goal to maximize life under repeated impact and compression cycles from a vehicle. A batch of flexors, for converting vertical compression into horizontal extension, was fabricated and calibrated with force transducers and strain instruments to ensure proper specifications. A uniform subscale piezo-ceramic stack prototype was fabricated and assembled to prevent stress concentrations under buckling loads.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Habitat Influences on Desert Tortoise Translocation Success

[EPC-16-053]

Recipient/Contractor:

Zoological Society of San Diego dba San Diego Zoo Global

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/22/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

With planned expansions in the California deserts, renewable energy projects potentially represent a major contributing factor in the continued decline of the threatened Mojave Desert tortoise. Head-start methods have been identified as a potential recovery tool and mitigation action for the desert tortoise, but current methods that rely on more than 4 years in captivity are expensive and therefore may be impractical.

Project Description:

The recipient is determining if habitat characteristics of the release sites can improve survival rates of smaller juveniles to the point that they are equivalent to the rates of the animals that were released only after reaching the desired size target. Careful measurement of resources that may help tortoises avoid predation or meet nutritional requirements will allow investigators to differentiate excellent habitat from merely adequate habitat. They are also studying the effects of outdoor rearing on juvenile desert tortoise behavior and health, and size-age relationships to survival in the wild upon their release. The project will generate quantitative, defensible information about the most cost-effective husbandry and release methods during and following a head-start program for this threatened species.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on Mojave Desert tortoises. This will be achieved by evaluating the relative effectiveness of head-start and release methods in an experimental framework. Improvements to the effectiveness of habitat management to encourage natural recruitment of juveniles will also be tested experimentally where possible.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 3b, 4f

Lower Costs:

This project is expected to lower costs by making head-start mitigation more cost-effective, reducing obstacles to future renewable energy deployment. It is important to determine the best practice methods for head-starting juvenile tortoises, including reducing time spent in captivity and increasing survival in the wild after release. This will minimize mitigation costs and maximize the contributions of these actions to desert tortoise recovery.

Environmental Benefits:

New scientific knowledge on minimum size required at release will guide release site selection and management in the future, while improving survivorship, resource needs, and translocation practices. A better understanding of the habitat features that allow tortoises to thrive can also be applied to guidance to wildlife agencies about which land parcels to protect and set more meaningful restoration targets. Implementation of more effective mitigation practices may increase probability of de-listing the desert tortoise from the endangered species list in the future. Lessons from the 2018 nest failure will provide important guidance for future mitigation efforts.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $32,237	
EPIC Funds Encumbered: $499,605		**EPIC Funds Spent:** $127,298	
Match Partner and Funding Split: Zoological Society of San Diego dba San Diego Zoo Global: $390,528 (43.9 %)		**Match Funding:** $390,528	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 14 out of 14 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project completed hatching of the first cohort of 63 hatchling tortoises at Edwards Air Force Base. This number should be sufficient for the 18-month old group to be released in 2020. Unfortunately, there was complete nest failure at the Cadiz site, so no hatchlings were produced there. With the advice and consent of the TAC and the agreement manager, researchers have a plan to overcome this setback with next year's cohort at Cadiz. They will attempt to collect a larger number of eggs in 2019 so that half could be reared indoors to reach the size the 18-month cohort would have achieved. The team is searching for a facility to conduct the indoor rearing. Investigating the cause of the nest failure should lead to improved guidance for future head-starting actions. The project team is collaborating closely with a complementary project (EPC-16-038), including using a common TAC.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services

[EPC-16-054]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/30/2017 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.

Issue:

The CPUC defines electric vehicles as a distributed energy resource along with distributed renewable generation resources, energy efficiency, energy storage, and demand response technologies. There is an issue with integrating and synchronizing vehicle-to-grid (V2G) with the utility, independent system operator, and local distributed energy resource management systems to optimize customer mobility needs and grid energy efficiency. The CPUC 'California Storage Mandate' requires investor owned utilities to procure and operationalize 1.3 gigawatts of storage with a provision that V2G technologies are viable for meeting the mandate requirements.

Project Description:

This project develops a "3-in-1" smart inverter, charging station, and building management system. The project focuses on defining and developing control algorithms to implement vehicle-to-grid (V2G) and vehicle-to-building (V2B) with minimal impact to the plug-in electric vehicle (PEV) battery life. This project develops and demonstrates the Smart Power Integrated Node (SPIN) device which is an off-vehicle, V2G power conversion and control device that can be applied to residential and small commercial applications. The system integrates a bidirectional direct-current (DC) PEV charger, photovoltaic inverter, and stationary storage battery, with an integrated local energy and power management system for power and energy management, grid communications, and ancillary services.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will determine the strategies and methodologies for V2G to become a value-added distributed energy resource (DER) asset to reduce ratepayer peak demand and defer grid upgrade costs. Results will inform investor-owned utilities on how V2G/V2B can be a viable resource to meet the Assembly Bill 2514 Storage Mandate and the CAISO energy

storage and distributed energy resource initiative. The project will enable validation and valuation of the most effective use cases and intelligently aggregate distributed energy resources to enable and accelerate V2G/V2B charging and discharging strategy adoption to alleviate constrained distribution system nodes.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007

Applicable Metrics: CPUC Metrics- 1c, 1e, 2a, 3f, 4a, 5b

Lower Costs:

The project will mitigate distribution system stress and maintenance costs through institution of microgrid and zero net energy operational modes utilizing V2G integrated building DER management and control. The increased integration of renewable energy with V2G-enabled PEVs can provide a value of over $350 million per year in added capacity and reduced grid congestion.

Greater Reliability:

The technologies developed under this project can provide ancillary services by combining V2G enabled vehicles' charge and discharge profiles that are locally and distribution system constrained to alleviate localized hotspots. The V2G services will smoothen the grid load profile by charging batteries during renewable over-generation and discharging back to the grid during peak load periods can provide approximately 2,000 MW of capacity to the grid.

Environmental Benefits:

The V2G-capable PEVs can enable higher penetration of distributed PV by mitigating renewable energy over-generation.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$370,849
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,500,000	$134,651
Match Partner and Funding Split:	**Match Funding:**
Flex Power Control, Inc.: $760,000 (19.8 %) Electric Power Research Institute, Inc.: $1,220,140 (31.8 %) Oak Ridge National Laboratory: $250,000 (6.5 %) National Renewable Energy Laboratory	$2,341,001

<table>
<tr><td colspan="2">(NREL): $110,861 (2.9 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
29 out of 31 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

IEEE 2030.5 Software - A platform independent software implementation of IEEE2030.5, that provides all of the functions required to implement a Server, Client and Gateway. This implementation may be ported to both embedded, SBC or a Cloud processor. An extensive set of API’s allow the development of powerful applications.</td></tr>
<tr><td colspan="4">Update:
The project team defined the SPIN functional requirements and interface protocols for bidirectional power flow, renewable energy generation, and battery energy storage management and control integration. The team developed software and interface architecture using the defined priorities and roles of the SPIN controller and the building management system/microgrid controller. The project team also developed the aggregator and distribution system operator server to send test demand response signals and smart inverter commands to the SPIN emulator. The team integrated the transformer management system (developed under EPC-14-086) to aggregated multiple SPIN systems.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers

[EPC-16-055]

Recipient/Contractor:

Zeco Systems dba Greenlots

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/30/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.

Issue:

With new PEVs having larger batteries and faster charging capability, direct current (DC) fast chargers for intra- and intercity quick charging needs have risen in demand. DC fast charging is expensive to operate due to high demand charges, and cause high stress on the distribution circuits to provide the charging power. There is currently no way to manage these demand charges or create any potential new revenue streams to the operator by providing additional services to the grid. Unmanaged DC fast charging can cause the demand load and grid congestion to grow exponentially as more DC fast chargers are installed at a site.

Project Description:

The project enables day-ahead and real-time pricing for DC fast charging by developing an integrated hardware and software platform to reduce demand charges from DC fast charging and address intermittency and renewable energy over-generation issues. The site controller and network-based platform advances smart and efficient charging by managing four multi-port fast charging stations to minimize grid impact and lower the cost of operating fast chargers, evaluates suitability of DC fast charging to participate in demand response programs, and develops and evaluates advanced technologies to efficiently integrate second-life PEV batteries for demand management with DC fast charging. By addressing intermittency and renewable energy over-generation issues, the project will reduce grid impact and increase renewable penetration in the grid by aggregating four DC fast charging stations with stationary battery storage from second-life PEV batteries.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is advancing the aggregation of DC fast chargers to optimize vehicle charging from either the grid or the stationary battery storage based on the day-ahead and real-time pricing data from the electric utility to reduce grid congestion and mitigate renewable energy

over-generation. This optimization will lower the cost of EV charging, directly translating into cheaper PEV charging for the ratepayers and increase PEV penetration.

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007

Applicable Metrics: CPUC Metrics- 1e, 1h, 2a, 4a

Lower Costs:

Integrated DC fast charging management with second-life PEV batteries offers lowered operating costs, and can increase operating revenues by more than $4,000 per year for each DC fast charger.

Greater Reliability:

Intelligent software control will enable the availability of flexible capacity to the grid, which will allow additional renewable integration and reduced stress on grid during peak hours with demand response capacity.

Environmental Benefits:

Using second-life lithium batteries removed from PEVs as energy storage provides another marketable use for these batteries and an alternative to disposal or the more expensive option of recycling.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $826,250	**EPIC Funds Spent:** $388,196
Match Partner and Funding Split: Zeco Systems dba Greenlots: $302,008 (26.8 %)	**Match Funding:** $302,008
Leverage Contributors:	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	29 out of 31 bidders	Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

- The patent covers a case when a charge station does not have a direct connection to the network. The patent also includes the concept of queuing, with messaging to drivers to increase utilization of charging stations.
- The patent application is for methods to calculate the likelihood of a demand response event or change in real time price based on measurements from a distributed network of sensors.

Update:

The project team has completed development, testing, and integration of the demand response functionality into Greenlot's SKY (cloud) platform. Greenlots is building the base platform and algorithms to support the hardware integration. Smart charging algorithm performance testing and optimization on multiple level 2 PEV chargers is ongoing.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Performance Evolution, Specification and Verification of Building Control Sequences

[EPC-16-056]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/10/2017 to 12/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

In most cases, occupied commercial buildings fail to perform up to their technical design and equipment specifications. Annually, more than one quad/year is wasted from common deficiencies in building control design and operation. Building designers who wish to reduce energy use via control strategies lack tools to compare energy opportunities.

Project Description:

The project is developing a design tool that can be integrated with OpenStudio and similar design software. The goal is to develop an integrated set of tools to enable design engineers to use energy-efficient ASHRAE-developed or custom control sequences for commercial buildings, specify them for control providers, and then verify their correct implementation. The project is expected to reduce the time to specify, implement and verify the proper operation of control sequences. Use of the design tool could enable more efficient building operations and reduce operating costs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This federal cost share grant with the US Department of Energy, will develop open source tools to enable verification of building control strategies and will integrate building controls, lighting and HVAC with the smart grid to provide fast and slow demand response. The breakthrough will be that designers can use pre-tested ASHRAE building control sequences or custom sequences, adapt and optimize, and test their impact on energy, peak power reduction, indoor air quality and thermal and visual comfort. The control sequences can be exported to the control vendor to obtain cost estimates and can be used by commissioning agents to verify that the original design intent is realized. This will enable accountability for controls performance between design and operation and is expected to have broad adoption and impact.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 3a, 3b, 3f, 4a
Lower Costs:
Use of the tools could reduce energy use in commercial buildings and equipment maintenance costs. Benefits will occur due to improved design and implementation of building controls. If this technology was widely adopted for existing buildings and achieved a 12 percent reduction in energy use, potential cost savings could be as high as $120 million per year.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$473,633</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,000,000</td><td colspan="2">EPIC Funds Spent:
$204,265</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
United States Department of Energy: $2,000,000
Kilowatt Engineering, Inc. dba kW Engineering, Inc.: $20,000
Stanford University: $75,000
Integral Group, Inc.: $75,000</td><td colspan="2">Leveraged Funds:
$2,170,000</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
43 bidders</td><td>Rank of Selected Applicant/ Bidder:
N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Terms and Conditions.
Update: This project is more than halfway complete. The recipient has collected data on a case study at Oracle and will develop additional sequence verifications between the collected data and controls description language.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Development of Smart Charging Infrastructure Planning Tool (SCRIPT) [EPC-16-057]	
Recipient/Contractor: Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 6/30/2017 to 7/31/2020
Program Area and Strategic Objective: Applied Research and Development S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.	
Issue: Plug-In Electric Vehicle (PEV) growth will add stress to the grid when charging demand is at a similar space and time. There is also a tradeoff between maximizing the use of PEV charging infrastructure and building more infrastructure to facilitate flexibility and market growth. For example, a congested charging station would not have much flexibility for demand management through smart charging. However, an expanded charging infrastructure network would allow PEVs to stay plugged longer than the minimum time required to finish charging without affecting other drivers' travel plans. Thus, providing additional flexibility for smart charging is desirable but needs to be done at a certain cost.	
Project Description: This project develops the Smart Charging Infrastructure Planning Tool (SCRIPT) that produces spatial-temporal forecasts of electric vehicle (EV) charging demand and flexibility. SCRIPT will determine daily predictive smart charging strategies that foresee the future travel needs of drivers and grid conditions. SLAC is studying the role of different charging infrastructure investment strategies in the effectiveness of EV smart charging techniques to accommodate state level renewable penetration goals in California. SLAC will test the tool using real-time charging data to determine the maximum amount of solar generation that can be absorbed by the vehicles through smart charging. SLAC will also study the trade-offs between investing in new charging infrastructure compared to better management of existing infrastructure via smart charging.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: There are significant benefits from workplace smart charging that may be shared with the vehicle owners. By exercising the flexibility of the vehicle charging in the workplace, commercial customers can save from energy and demand charge costs. Smart charging can	

<table>
<tr><td colspan="4">decrease energy charges by up to 1.5% of the overall utility bill, and decrease demand charges by up to 24.7%. Further benefits can be achieved from adding PV to the distributed energy resource at a site, even without that addition, there is significant benefit to both the EV owner and workplace where the EV is being charged.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Alternative Fueled Vehicles: R.13-11-007</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1e, 1f, 3a, 3f, 4a, 5b
Lower Costs:
The predictive smart charging system allows PEV owners to charge during the periods of the day when energy is the cheapest. SCRIPT also allows for intelligent management of the existing charging and grid infrastructure which reduces maintenance costs and future equipment costs.

Greater Reliability:
SCRIPT's predictive smart charging algorithms will allow PEVs to intelligently charge during periods of renewable energy overgeneration, which reduces the amount of energy flowing back into the distribution grid.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$328,945</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,500,000</td><td colspan="2">EPIC Funds Spent:
$660,641</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
ChargePoint, Inc.: $32,808 (2.1 %)
UC Santa Barbara: $61,345 (3.8 %)</td><td colspan="2">Match Funding:
$94,193</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
29 out of 31 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: SLAC's Smart Charging Infrastructure Planning Tool (SCRIPT) project is in the data ingestion phase, using a ChargePoint dataset encompassing commercial and residential EV charging history from 2015-2018 in the San Francisco Bay Area that will be integrated in the visualization and Analytics of Distributed Energy Resources (VADER) platform to inform SCRIPT. In addition, a task focused on time series analysis will be performed on the EV demand and flexibility data to produce forecasts produced from a model which takes user input scenarios for varying EV growth, travel demand growth, and regional goals. The forecasts will enable a smart charging algorithm to be developed that will determine the optimal charging scenario for each aggregation of charging equipment, maximizing solar charging and minimizing costs (e.g. electricity, infrastructure expansion) while meeting driver mobility needs.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Advanced Transit Bus VGI Project [EPC-16-058]	
Recipient/Contractor: Prospect Silicon Valley	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 5/15/2017 to 12/31/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.	
Issue: California has established ambitious goals for zero emissions vehicles (ZEV), including the California Air Resources Board proposed initiative for 100% transit conversion to ZEVs by 2040. Currently, electric buses (e-bus) are significantly more expensive than conventional buses and are complex and costly to integrate into current transit agency bus operations (e.g., integrating into existing routes because of charging needs). However, there is the potential to get more value out of the e-buses to support state renewable goals and grid reliability.	
Project Description: This project addresses critical real-world needs to commercialize and scale electric transit fleets with robust grid-serving energy services. Leveraging Santa Clara Valley Transit Authority's (VTA) plan to purchase up to 35 all-electric buses to electrify its 500-bus fleet, the project team will demonstrate strategies to improve the business case of e-buses, including reducing cost via advanced management, establishing revenue generation opportunities, addressing commercial fleet management needs, and ensuring benefits reach all communities by delivering e-bus transit to underserved communities.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The project will make the following advances: translate automotive VGI advancements to a commercial e-bus fleet, including retail and wholesale energy services; deliver advanced optimization of battery life and cyber security; integrate energy services and management with leading commercial fleet management tools; integrate key Energy Commission funded VGI platforms and provide a roadmap for statewide deployment.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007

Applicable Metrics: CPUC Metrics- 2a, 4a, 4b

Lower Costs:

The project will lower costs for transit agencies including a projected $220K per year in reduced demand charges and energy services revenues from this pilot. The project will also result in reduced grid costs by providing significant grid services at lower cost than dedicated assets purchased for such services.

Environmental Benefits:

Accounting for CA electric carbon intensity, this project will reduce 4,000 metric tons of CO2 (MMtCO2) per year representing a 78% reduction from the current buses. A statewide conversion would reduce 2.4 MMtCO2 per year - 1.5% of current statewide transportation carbon emissions.

Public Health:

Conversion to e-buses significantly reduces criteria pollutant emissions, particularly NOx, CO, VOCs and particulate matter, especially important for underserved communities. For the pilot, assuming replacement of typical diesel buses, annual reductions of up to 255,000g CO, 21,000g hydrocarbons, 3,200g NOx and 170g PM could be achieved. VTA serves an estimated 500,000 residents in underserved communities.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $1,899,199	**EPIC Funds Spent:** $292,649
Match Partner and Funding Split: Santa Clara Valley Transit Authority: $1,005,018 (34.3 %) Proterra Inc.: $30,000 (1.0 %)	**Match Funding:** $1,035,018
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	29 out of 31 bidders	Group 4: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-058 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team installed charging stations to support the first five electric buses added to Santa Clara Valley Transit Authority's fleet. The team completed development of the e-bus integration and acceptance test plan and developed a preliminary analysis of the impacts of a complete e-bus fleet. The team is now focused on developing the Energy Management Platform which will serve the smart charging needs of the electric fleet and be used to determine best practices for wide scale adoption.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Service and Renewable Power Penetration

[EPC-16-059]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	10/11/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.

Issue:

Plug-in electric vehicles (PEVs) can provide energy storage needed to support renewable power generation through vehicle-to-grid (V2G) and vehicle-to-building (V2B) services. However, the risk of accelerated battery degradation is commonly cited as a concern inhibiting implementation of V2G and V2B technology. Additionally, second-life battery applications can provide value after a battery pack has exhausted its useful life in a vehicle. To bolster stakeholder confidence in V2G, V2B, and second-life battery applications, real-world demonstrations are needed to complement existing battery degradation models and projections.

Project Description:

This project demonstrates an automated control system for a fleet of PEVs and repurposed second-life batteries that reduces the overall cost of ownership by maximizing battery lifetime, shifting load to reduce electricity and demand charges, and providing V2G and V2B services, including those supporting the use of onsite solar generation. The demonstration adds a stationary second-life battery installation to the existing PEV fleet site at the Los Angeles Air Force Base.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is developing and implementing an optimization and control algorithm for a fleet of PEVs and stationary battery packs that includes impacts on battery health expressed as an economic cost, using models and parameters derived from actual battery measurements. These activities will help demonstrate PEV ownership lifecycle cost reductions and will advance scientific knowledge of the impacts of V2G and V2B services on mobile and second-life PEV batteries.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Energy storage: R.15-03-011 [Closed]

Applicable Metrics: CPUC Metrics- 1h, 3f, 4b

Lower Costs:

The project reduces the lifecycle cost of PEV ownership for fleets by increasing the useful capacity and lifetime of PEV batteries, including accounting for recycling costs and waste generation from manufacturing new batteries. Utility costs can also be lowered through load shifting and demand management. Given the assumptions about 10% of commercial and government fleet vehicles in California that would convert to PEV and the corresponding number of second-life batteries that could be installed at fleet sites, the per battery (both PEV batteries and second-life batteries) savings from peak demand shifting is estimated to be about $400 per year or $62M per year in aggregate.

Environmental Benefits:

PEV batteries removed from transportation service, but retained as storage assets at their primary location, will result in significant increases in useful service life prior to recycling. Furthermore, a California Energy Commission report forecasting the potential impacts of second-life batteries predicted that 15% of the expected annual reduction in greenhouse gases could be achieved using second-life batteries for peak shifting.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $407,071	
EPIC Funds Encumbered: $1,500,000		**EPIC Funds Spent:** $701,533	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 29 out of 31 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 2

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Thirteen existing charging stations have been retrofitted to support testing. Also, as of November 2018, 10 charging stations are up and running; the remaining three charging stations will be in service soon. The research team designed the sensor package to measure battery temperature and state of charge in the PEVs and developed an approach to estimate and predict battery degradation.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Intelligent Electric Vehicle Integration (INVENT) [EPC-16-061]	
Recipient/Contractor: Nuvve Corporation	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 7/3/2017 to 12/31/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.	
Issue: As the PEV population grows in California, the demand for electricity as a transportation fuel may lead to congestion and overloading on the transmission and distribution grid. Simultaneously, increasing the introduction of renewable energy sources requires more closely coordinated grid capabilities being adopted to effectively regulate grid voltage and frequency on a real time basis and especially to address the issues pertaining to morning and afternoon ramping.	
Project Description: This project is deploying vehicle-grid integration (VGI) technology with unidirectional and bidirectional power flow capabilities using light fleet and consumer vehicles. These vehicles will provide local grid support by controlling the charge rate based on energy and power capacity available locally, controlling the voltage, and providing grid-wide support by participating in frequency regulation or adjusting the reactive power. The mix of services provided will be optimized within a campus laboratory setting with the goal of expanding this technology into a real-world setting.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project is developing an advanced VGI technology to optimize the blend of unidirectional charging, bidirectional operation, and vehicle-to-building functions, for different real world grid applications such as frequency regulation, power quality, voltage control, and grid support. The project will show the value of EVs as distributed energy resources, with the ability to defer or eliminate the need for grid upgrades, and enable greater renewable energy penetrations.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project: Alternative Fueled Vehicles: R.13-11-007 Distribution Resources Plans (AB 327): R.14-08-013	
Applicable Metrics: CPUC Metrics- 1h, 3f, 4b Lower Costs: The combination of load adjustment and energy storage is the most cost-effective way to integrate PEV and renewable energy sources at the same time. By sharing the battery in a PEV when the PEV is not used (parked and connected) the grid will have access to a low cost distributed storage resource, which in turn will make it possible to introduce more non-dispatchable renewable energy such as solar or wind. Greater Reliability: Since the batteries in the EVs function as distributed storage resources, they can improve grid reliability by stabilizing the grid-wide frequency as well as mitigating local grid overload in transformers or feeders. Environmental Benefits: Helping to make EVs more affordable by identifying revenue creating strategies will increase the penetration of EVs. This will help to lower the local pollution by reducing fossil fuel consumption within local transportation, especially in large cities.	
Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $4,200,000	**EPIC Funds Spent:** $706,488
Match Partner and Funding Split: The Regents of the University of California, San Diego: $335,604 (4.2 %) Strategen: $13,100 (0.2 %) FleetCarma: $13,892 (0.2 %) Nuvve Corporation: $3,335,148 (42.2 %)	**Match Funding:** $3,697,744
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	29 out of 31 bidders	Group 4: Ranked # 5

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The owner of the Patent is the University of Delaware with patent number 9,043,048, and the length of the patent is from Sep. 21 2010 through May 26 2015.

Update:

The project team installed 18 Phase I charging stations on the UC San Diego campus. The team then completed commissioning of the unidirectional and bidirectional chargers and vehicles. Testing included manual charging and discharging of EVs to demonstrate the functional performance of the chargers and vehicles. The unidirectional chargers were tested on 8 vehicles including BMW i3, Chevy Bolt, Tesla Model 3, Smart cars, and the UCSD facilities' EV fleet. The bidirectional chargers were tested of the 9 bidirectional (VG2) units with Nissan LEAFs and a Mitsubishi Outlander, which have V2G capabilities. The team has begun to assess the impact of the vehicles on the UC San Diego demand charges and is beginning simulation of frequency control with the system.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Advancing Demand Response in the Water Sector

[EPC-16-062]

Recipient/Contractor:

Regents of the University of California, Davis

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/5/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Water utilities are high electricity users responsible for about 10% of the state's electricity demand, but lack the ability to easily participate in demand response events or shift loads to reduce their energy costs. A water utility's energy uses are complex and their understanding of effective ways to meet inflexible demand needs and also electric load management for demand response is lacking. Finding feasible, energy cost saving solutions requires assessment of the conditions at the plant, the system configuration, and assessing real time water and energy data.

Project Description:

This project is developing a demand management system to optimize energy use and operations using the Moulton Niguel Water District as a pilot site. By better optimizing its system, the water utility will be able to reduce its energy bill by participating in demand response and load shifting incentive programs. The project will optimize load for the potable and recycled water systems at Moulton Niguel while developing a software platform and management system that can be easily adopted by other water districts and utilities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The demand management system uses real-time energy analytics to: (1) reduce and/or shift peak energy loads, (2) account for different energy tariff structures, and (3) balance the grid's intermittent renewable load generation. This demand management tool enables water utility participation in demand response and load shifting utility programs. Along with marketing and communicating the technology, the tool will inform other water utilities, and could result in increased use and acceptance. Given the impact of energy consumption by the water industry in California responsible for 10% of the state's electricity demand, widespread use of the proposed methodology could help achieve energy demand reduction needed to support the state's energy goals.

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CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 1g, 1h, 2a, 3h, 4a

Lower Costs:

This project could lower costs for the water utility through participation in energy utility demand response programs. It could also result in a reduction in system costs through avoided demand charges and reduced constraints on the electric grid during congested periods. Moulton Niguel is expected to reduce peak demand by 25% using the technology solution.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $282,171
EPIC Funds Encumbered: $2,984,983	**EPIC Funds Spent:** $95,959
Match Partner and Funding Split: Moulton Niguel Water District: $90,865 (2.9 %) Helio Energy Solutions: $14,900 (0.5 %)	**Match Funding:** $105,765
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant		

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The intellectual property contains patent and trade secret to "PredictEnergy" software owned by Helio Energy Solutions. The proprietary technology will be used to develop the products in multiple tasks in this agreement.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

The team has developed a hydraulic model of the Moulton Niguel Water District water system that will be used to develop and test energy management strategies. The team is also refining data and inputs to the energy demand management system software, including gathering tariff and grid operation characteristics information from the utilities and the California Independent System Operator. The research team has completed a Hydraulic Model Display and Results Report which contains a full analysis of the reclaimed and potable hydraulic models at the water utility.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning

[EPC-16-063]

Recipient/Contractor:

University of California, San Diego

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/30/2017 to 8/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

There are two basic ways to produce climate scenarios for California. One of them involves the use of dynamic regional climate models. These "weather forecast models" are very expensive to run. The second option is to use statistical methods that use historical relationships with outputs from global climate models to create high resolution climate scenarios for California. This approach is far less expensive than running an entire weather forecast model but it is unclear if the historical statistical relationships will be valid under future conditions. The researchers will develop and test a hybrid downscaling technique that will merge the benefits of statistical and dynamic models.

Project Description:

This project develops new and better ways of merging the two approaches, using both weather forecast models (more generally called dynamical models) and inferences from past history (statistical models). The combined method is called a hybrid dynamical-statistical approach for inferring fine-resolution climate information from the coarse-resolution global climate models. Ideally, the hybrid approach will be able to capture many of the physical processes simulated by the costly weather forecast models, but with the reduced expense of statistical models. The hybrid approach will be applied to three key areas of California's climate that have important implications for the state's ratepayers: wind, clouds, and hydrology: wind, clouds, and hydrology.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will include an extensive quantification/measurement (model validation) effort, which will be based on data from observed meteorological stations and existing coastal upwelling indices (for wind), satellite records of low cloudiness compiled by project members (for cloudiness and aerosols), and USGS stream-flow and groundwater observations (for the hydrologic modeling). The method under development could be used for California's Fifth Climate Change Assessment and future energy planning.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 5c

Lower Costs:

Knowing how the climate is likely to change provides a sound scientific basis for minimizing economic impacts on the electricity system. For example, better projections of wind fields at heights of interest to wind generation and at appropriate time scales (i.e., sub-daily) will help guide long-term planning for wind generation. Improved, cost-effective planning for integration of renewables to meet California's Renewables Portfolio Standards potentially has significant benefits for California ratepayers.

Greater Reliability:

This research will develop a method to produce high-resolution projections of climate parameters that are of great importance for managing the electricity system, in particular for managing peak demand and for shifting to a grid that is dominated by low-carbon, intermittent resources. For example, improved understanding of how low-lying coastal cloud cover is projected to evolve can improve planning for peak demand. Similarly, improved understanding of availability of intermittent renewable generation fosters better management. This potentially has significant benefits in the form of increased reliability for California ratepayers.

Increase Safety:

This research offers enhanced GCM resolution for predictive modeling. therefore, knowing how the climate is likely to change means that the effects on the state's residents, infrastructure, and economy can be minimized. This potentially has significant benefits for California ratepayers

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Grid Operations/Market Design	$192,928

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,399,888</td><td colspan="2">EPIC Funds Spent:
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$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
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$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
14 out of 14 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 6: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project started late in the summer of 2017. The research team is running dynamic regional climate models and exploring the use of statistical models for hourly simulations. In the past, climate scenarios for California only included projections with daily resolution. The Energy Commission's Energy Forecast Office is moving towards hourly forecasts</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Investigating Avian Attraction to Solar Energy Facilities Through a Lake Effect [EPC-16-064]	
Recipient/Contractor: US Geological Survey	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 3/11/2018 to 6/30/2020
Program Area and Strategic Objective: Applied Research and Development S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.	
Issue: PV utility-scale solar facilities in California (and elsewhere) are sources of bird mortality. Currently, it is unknown what behavioral processes and mechanisms lead to bird mortality observed at solar facilities. The leading hypothesis suggests that large fields of photovoltaic panels reflect light in a manner similar to large bodies of water. Moreover, the presence of these water-like surfaces in arid landscapes may add to their attractiveness to passing birds. Left unaddressed, this problem will lead to increased costs to ratepayers as solar energy projects face greater environmental permitting challenges associated with developing and operating these facilities.	
Project Description: Researchers are exploring the behavior of attraction by birds to solar facilities, particularly in relation to the "lake effect" hypothesis. Specifically, they are studying 1) the ability of birds to detect potentially attractive visual cues associated with solar facilities (e.g., polarized light, irradiance); 2) the corresponding change in flight behavior characteristic of movement toward solar facilities; and the 3) mortality and natural history of birds that actually occupy solar facilities. First, the recipient is examining the sensory basis of attraction through field and lab experiments. Second, radar and thermal imaging are used to measure the degree to which birds alter their flight paths to settle at solar facilities. Data on behavior and mortality from multiple solar facilities are gathered to inform a statistical model to determine what characteristics of solar facilities and species' natural history together explain variations in mortality exhibited across sites.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project is the first systematic study to determine whether birds are attracted to solar energy facilities and if so, to develop an understanding of the sensory basis and proximal	

response of birds to solar facilities in relation to the "lake effect" attraction phenomenon. Following from that new understanding, the project will identify potentially viable methods for deterring birds from approaching solar facilities and informing future siting decisions in ways that reduce the likelihood of birds encountering solar facilities.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 4f, 4g

Lower Costs:

This project will lower costs by streamlining the permitting process of renewable energy projects in California. Renewable energy projects are often delayed because information on the impacts on wildlife required by state and federal law is insufficient or unavailable. Better information on the effects of these projects will reduce permitting delays. The findings of the research may also help to focus pre-construction surveying and post-construction monitoring and mitigation actions to the species at greatest risk from this form of attraction, which would also reduce the soft costs of deployment of solar energy technologies.

Environmental Benefits:

By combining mortality and natural history data with new data gathered during the project, solar energy companies, state and federal agencies, and the public will have access to the best information for risk assessment and future siting decisions. The eventual adoption of such techniques reduces the likelihood that solar facilities impact species of concern, particularly state and federal threatened and endangered species. Suggestions for deterrent and mitigation strategies may lead to the application of technologies that reduce bird mortality.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$177,072
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$499,785	$252,200
Match Partner and Funding Split:	**Match Funding:**
United States Geological Survey: $348,152 (28.1 %) Bard College: $75,390 (6.1 %) Humboldt State University Sponsored Programs Foundation: $12,244 (1.0 %) 8minuteenergy Renewables, LLC: $50,000 (4.0 %) First Solar: $50,000 (4.0 %)	$740,251

<table>
<tr><td colspan="2">NextEra Energy: $50,000 (4.0 %)
NRG Energy, Inc.: $50,000 (4.0 %)
Recurrent Energy: $100,000 (8.1 %)
Western EcoSystems Technology, Inc.: $4,465 (0.4 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
14 out of 14 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This agreement was approved at the May 2017 business meeting, but the agreement could not be executed until March 2018. The first field season of data collection was successfully completed for both radars at the Desert Sunlight solar facility, and bird carcass search, and bird use surveys at several additional solar photovoltaic facilities across southern and central California. These data are being analyzed. The experimental tasks to study bird attraction to polarized surfaces is in the planning and preparation stages.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

California E-Bus to Grid Integration Project

[EPC-16-065]

Recipient/Contractor:

Zero Net Energy (ZNE) Alliance, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/30/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.

Issue:

On-road diesel emissions are a key factor in lung disease and the state's asthma epidemic. Electrification of transit represents a tremendous opportunity to achieve cornerstone climate goals such as Assembly Bill (AB) 32, State Bill (SB) 350, and Executive Orders B-30-15 and B-16-2012. Cost and reliability are the largest barriers to scaled adoption of electric buses (E-bus). For transit fleets there is the added challenge of integrating E-buses into their bus schedules and ensuring that drivers are properly trained on how to operate them.

Project Description:

This project focuses on improving the economics of incorporating e-buses in a transit agency fleet. The project team is working with the Antelope Valley Transit Authority (AVTA) to evaluate multiple potential benefits, including smart charging, improving vehicular energy efficiency through best driving practices, and using the vehicle batteries for grid services when the E-buses are not being used for their routes. More effective smart charging reduces the frequency and duration of in-route charging, and the fuel economy improvements that come from smart driving result in operational cost savings. By reducing the likelihood that several/all E-buses will be charging at once, the smart charging platform will achieve greater flexibility to mitigate demand charges and provide grid services.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

E-Buses have the technical and economic potential to rapidly displace diesel and CNG transit buses given current replacement cycles. Buses are being deployed with onboard telematics to understand the vehicle's operating health and parameters, and high-power wireless inductive charging is now a viable solution for in-route charging. Together, these technologies help overcome range limitations and uncertainty. However, while these technologies alone provide great value and overcome key adoption barriers, integrating them with analytics and distributed energy resource (DER) management platforms will unlock even greater value.

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CPUC Proceedings addressing issues related to this EPIC project: Alternative Fueled Vehicles: R.13-11-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012	
Applicable Metrics: CPUC Metrics- 2a, 3f, 4a Lower Costs: This project evaluates the lifecycle costs of EV buses through smart charging operation which will smooth the demand spike during nighttime depot charging and demonstrate how to minimize demand charges during the day when buses need to be using high-powered chargers. By using suitable strategies, it is expected that EV buses will be shown to be more cost competitive with diesel buses. Greater Reliability: Enabling grid services to provide grid operators with the increased flexibility and resiliency required for the growing demands associated with renewable intermittency, excess generation, and portfolios of DERs. Traditional grid service providers are not able to adequately meet the increasing need for flexible ramping and frequency regulation. Public Health: The electrification of transit fleets would have enormous impacts on public health, as diesel use is one of the biggest sources of particulate matter and causes of childhood asthma. Additionally, the project will pave the way for greater transit vehicle electrification, which could ultimately save ~1.7 MMTCO2e per year in the State of California alone.	
Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $3,327,953	**EPIC Funds Spent:** $794,005
Match Partner and Funding Split: Antelope Valley Transit Authority: $3,729,000 (52.8 %)	**Match Funding:** $3,729,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	29 out of 31 bidders	Group 4: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team is working with AVTA on the installation and tracking of the Health Alert Management System (HAMS) electronic components as they are procured by AVTA. The HAMS will provide data essential to monitoring E-bus performance and identifying problems with E-bus operation. The team also installed two wireless chargers for the buses to test the ability to deploy them to more easily charge the buses when not in motion (e.g., at bus stops). The team created a model that will allow them to evaluate different use cases to identify the best revenue streams for the AVTA E-buses. The team is working on a driver training module to optimize the driver behavior for best energy efficiency results in assigned routes.

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Project Name: Robust Super Insulation at a Competitive Price [EPC-16-067]	
Recipient/Contractor: Lawrence Berkeley National Laboratory	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 7/14/2017 to 12/2/2020
Program Area and Strategic Objective: Applied Research and Development S11: Provide Federal Cost Share for Applied Research Awards.	
Issue: Currently, conventional building insulation is economical but has low R-values. There are emerging technologies with high R-values but are expensive. There is a need to develop a robust insulation with a high R-value to significantly reduce cooling and heating loads that can be sold at a competitive price.	
Project Description: Heating and cooling represents the greatest energy consumption in buildings. This project is developing thermal building insulation material with high R-value at a cost commensurate with conventional insulation materials. The product is expected to provide a significant increase in energy savings for existing buildings.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Currently, there is no thermal building insulation material that can cost-effectively be assembled with high R-values. This Department of Energy cost share agreement is developing a manufacturing process to achieve a high R-value and decrease the installed thickness of the insulation, at a competitive price. This will make retrofits easier because much less space will be needed to accommodate existing building wall assemblies.	
CPUC Proceedings addressing issues related to this EPIC project: Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]	

APPENDIX B:
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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1h
Lower Costs:
If successful, the insulation material could achieve 2 to 4 times increase in R-value at a price competitive with current insulation materials. This higher R-value will reduce heating and cooling costs to building owners and tenants.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$42,679</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$100,000</td><td colspan="2">EPIC Funds Spent:
$27,890</td></tr>
<tr><td colspan="2">Match Partner and Funding Split: N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
U.S. Department of Energy: $1,700,000</td><td colspan="2">Leveraged Funds:
$1,600,000</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
43 bidders</td><td>Rank of Selected Applicant/ Bidder:
N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Technical results will be made public after securing intellectual property, as is customary.</td></tr>
<tr><td colspan="4">Update:
The team is currently in the material testing phase, examining options to increase the flexibility of the insulation. Future work will involve analyzing the effects of nanoparticles on the thermal transport process, in order to estimate the insulating properties of the tested materials.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Integrated Community-Level Solutions for Resource Management for a Grid and Customer Benefits

[EPC-16-068]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	8/18/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

There is a need to ensure equal access to energy innovations to all sections of society and enable everyone to derive the economic and quality of life benefits from meeting California's energy and climate goals. To meet these goals, research gaps remain such as: (1) assessing new, high efficiency solar technologies that can address space constraints in commercial and multifamily buildings, (2) testing how integration of solar, energy storage, and connected end-use load control can potentially manage customer needs with electrical grid benefits and (3) evaluating approaches to enable community solar and storage as a tool to enable grid reliability.

Project Description:

This project demonstrates the feasibility of using an integrated community-scale solar plus storage system, sited at a low income multi-family disadvantaged community in Willowbrook, CA, as a distribution asset. The technology solution balances a combination of grid-connected distributed energy resources (DER), including advanced solar PV, energy storage, smart inverter, demand response, and load management. The project team is working with Southern California Edison to study the distribution grid impacts that the DERs can mitigate, realizing cost savings and enabling increased PV penetration. It is also investigating innovative business strategies to maximize the value of DER to both end-users and the utility. Another objective of the project is to demonstrate a cost-effective solution to achieving Zero Net Energy (ZNE) within an affordable housing community to realize California's 2020 goal for new sustainable and scalable ZNE communities.

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How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project includes high efficiency bifacial 355W solar modules that can substantially assist commercial and multifamily buildings with roof area constraints, as well as the integration of solar and storage with smart inverters that include segmentation of storage for meeting multiple needs. The project also demonstrates a platform that can manage both loads and storage while integrating DC mini grids to eliminate conversion losses for solar PV.

CPUC Proceedings addressing issues related to this EPIC project:

Self-Generation Incentive Program: R.12-11-005 Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a, 3f, 4a, 4b

Lower Costs:

The project will demonstrate energy savings of 231,240 kWh to the grid on an annual basis from the solar generation. With the inclusion of an additional 10% savings through reduction in conversion losses and another 10% through energy efficiency measures, the project will save 289,050 kWh annually. If this project were replicated to cover 15% of California residential energy use (20% of ratepayers are low income, and 75% of low income is multifamily), Californian's total energy bills would be reduced by $185 million per year.

Environmental Benefits:

The project shows a potential, if replicated to cover 15% of California residential energy use, for energy use reduction of 1089.4 GWh per year, which translates to statewide CO2 reduction of 397,631 tons per year.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$821,664
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$2,976,991	$119,351
Match Partner and Funding Split:	**Match Funding:**
E-GEAR: $137,564 (3.5 %) OhmConnect, Inc.: $108,000 (2.7 %) Chai Energy: $25,000 (0.6 %) EPC Power: $5,000 (0.1 %) Nextek: $10,000 (0.3 %) Prism Solar: $10,000 (0.3 %) Southern California Edison: $300,000 (7.5 %)	$1,002,900

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<table>
<tr><td colspan="2">Electric Power Research Institute, Inc.:
$407,336 (10.2 %)</td><td colspan="2"></td></tr>
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N/A</td><td colspan="2">Leveraged Funds:
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Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

EPRI developed a tool called the "Distribution Resource Integration and Value Estimation" tool or "DRIVE". The tool was developed through funding from EPRI's utility members. The tool is embedded in distribution planning software made commercially available by license. DRIVE is pre-existing IP.</td></tr>
<tr><td colspan="4">Update:
The Energy Commission issued a Stop Work Order (SWO) on August 31, 2018, since EPRI failed to execute a subcontract agreement with LINC Housing. As a direct result, this also delayed the execution of a subcontract between LINC Housing and Gridscape Solutions, which is directly responsible for designing, building, and developing control interfaces, performing laboratory testing, commissioning, and deploying the solar + storage system. The Stop Work Order was removed in December 2018.

EPRI has completed the Final Measurement and Verification Plan. An order was placed to procure (2) 110 kWh energy storage system and (4) 30kW inverters with an anticipated delivery by December 15, 2018.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Integrating Front-of-the-Meter Energy Storage with Smart PV Inverters and Solar Forecasting [EPC-16-070]	
Recipient/Contractor: Electric Power Research Institute, Inc.	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 6/30/2017 to 12/31/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market and Improve Grid Reliability.	
Issue: Although it is recognized that front-of-the-meter and community-scale storage projects can benefit the grid and provide greater value to customers, it is not yet clear what those values are, how they can be maximized, or how to minimize the impacts of a high penetration of renewables (e.g., in a community).	
Project Description: The purpose of this agreement is to design and install front-of-meter energy storage with smart PV inverters and solar forecasting. The research will demonstrate a cost-effective and scalable solution that integrates distributed energy resources to address grid needs and identify costs reductions and revenue generating opportunities for developers and commercial customers.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The project will demonstrate an interoperable solution that integrates front-of-the-meter energy storage with smart PV inverters and satellite-based solar forecasting to address grid limitations. The idea is to enable PV as a grid asset through beneficial integration with storage, capacity management, and communications. To accomplish this, advanced modeling techniques will be used including EPRI's existing tools for hosting capacity calculation and energy storage value simulation. Advancements that will result from this demonstration will enable aggregated DER control and optimization.	

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CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

Applicable Metrics: CPUC Metrics- 1a, 1e, 3a, 4a

Lower Costs:

This project will demonstrate the financial opportunities for front-of-the-meter storage. The demonstration will evaluate revenue streams that can defer the cost of the system and provide additional energy savings in a facility by reducing daily load.

Greater Reliability:

The project will provide new data, analysis and design for cost-effective integration of distributed PV with energy storage. This will improve reliability at two levels: (1) at the distribution system level, by mitigating adverse PV impacts such as voltage violations; and (2) at the bulk level, by leveling out the "duck curve" and limiting dependency on operating reserves.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $1,832,770		**EPIC Funds Spent:** $93,320	
Match Partner and Funding Split: Craig Wooster Engineering: $361,685 (14.9 %) Electric Power Research Institute, Inc.: $229,753 (9.5 %)		**Match Funding:** $591,438	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 31 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 6: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: EPRI has completed an analysis of the front of the meter storage envisioned in this project, including a detailed assessment of the value streams associated with this option. This work has generated valuable learnings in multiple areas: challenges with the interconnection process for front-of-the-meter storage; interconnection costs; compatibility of the proposed approach with the California Public Utility Commission framework on multi-user applications for storage; and technical challenges related to backup services and metering. The team is currently designing the system.

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Project Name: Valencia Gardens Energy Storage [EPC-16-073]	
Recipient/Contractor: Natural Capitalism Solutions, dba Clean Coalition	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 9/1/2017 to 6/30/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market and Improve Grid Reliability.	
Issue: Renewable energy combined with energy storage on the distribution grid has been acquired one rooftop at a time. These systems are developed without a clear understanding of their impact on the local grid or the advantages that energy storage in front of the meter could provide. The absence of an area-wide, integrated distributed energy planning process results in lost opportunities to accelerate the adoption and scale of distributed renewable energy while achieving a more operationally-viable and cost-effective outcome.	
Project Description: The purpose of this project is to utilize energy storage in front of the meter to increase the ability of the distribution grid to support more local solar, while improving overall grid operations and economics. This project will provide a replicable model for California by demonstrating multiple uses: interoperability with normal grid operations, including participation in existing wholesale market opportunities; and enhanced interconnection hosting capacity to accommodate far more local solar; and indefinite solar-driven backup power for prioritized loads. Additionally, this project will recommend advancements in policy, interconnection processes, and market mechanisms that maximize and recognize the full value of local energy storage deployments that are interconnected in front of the meter.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of California's statutory energy goals by utilizing energy storage as a local balancing and optimization solution on a circuit in the distribution grid. The project will demonstrate a combination of advancements and breakthroughs including, but not limited to	

an advanced local energy system that utilizes energy storage on a circuit to optimize local circuit balancing, increases PV hosting capacity, and provides the California Independent System Operator with ancillary services.

CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5b

Lower Costs:

The project team estimates that this system will result in $240,000 in peak capacity savings and $425,000 in transmission and distribution line loss savings.

Greater Reliability:

This project will enable higher penetrations of distributed renewable energy, improve circuit reliability and optimize local balancing of electricity supply and demand. It will utilize indefinite, renewables-based backup power to critical loads in a disadvantaged community during grid outages to achieve greater community resilience.

Environmental Benefits:

By enabling greater local penetration of PV, this project will contribute to a decrease in the reliance on fossil fuels for electricity generation, and thereby reduce greenhouse gas emissions and other hazardous emissions from power plants. The project team estimates that the10 MW of PV in the project area will yield 15,785 MWh of emissions-free generation per year, which is equivalent to offsetting the emissions of 2,052 average homes in PG&E territory.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $1,994,687	**EPIC Funds Spent:** $413,328
Match Partner and Funding Split: PATHION, INC: $620,470 (23.7 %)	**Match Funding:** $620,470
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	31 out of 35 bidders	Group 6: Ranked # 2
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-16-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: The project team developed the detailed design of the system and received approval of the Self Generation Interconnection Agreement with PG&E to demonstrate an in-front-of-the-meter energy storage system. Additionally, the interconnection agreement process was completed in November. The team also completed the site preparation and installation planning.			

APPENDIX B:
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Project Name:

Solar+ Storage Integrated Energy Management Demonstration in a Supportive Housing Facility

[EPC-16-077]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Riverside Campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	1/31/2018 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Current Photovoltaic (PV) generation and Battery Energy Storage System (BESS) activities do not adequately integrate the meter side community energy conditions and Utility Demand Response (DR) functions. BESS integrated energy management activities have the risk of potentially increasing peak demand and peak utility loads. Additional PV generation also increases generation uncontrolled by the utility. Unmanaged energy production and storage creates additional challenges for utility energy management and distribution. Commercially viable products have failed to materialize with solutions to existing barriers, dampening market interest.

Project Description:

The project deploys a 100 kW high-performing solar PV system, a 150 kW/150 kWh li-ion battery energy storage system, and an advanced energy management platform (smart inverter) to demonstrate the advancement of these technologies compared to standard commercially available products. These components will be integrated to optimize flexibility in demand side energy management through Load Shifting, Solar PV Self-consumption, Emergency Back-Up, Demand Response, and Ancillary Grid Services. The proposed system will be able to autonomously meet demand response and energy management requests while critical loads at the building are maintained, minimizing operational impacts.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project integrates energy storage and PV technology with advanced control algorithms and smart inverter autonomous functions. The solar+ system uses high efficiency solar panels DC coupled with Li-ion battery storage and demonstrate various smart inverter functions to provide autonomous grid services and energy management practices under a

variety of operational conditions. The team is assessing the impact smart inverter-provided grid services and solar + storage operation have on each other. The project provides BESS and PV technology integrated with an energy management system to support diurnal energy loads. This project implements utility initiated DR functions and creates an architecture that allows expansion to future power regulation and potential wholesale market participation.

CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed] Distribution Resources Plans (AB 327): R.14-08-013 Smart Inverter: D.14-12-035 (in R.11-09-011) Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1g, 1h, 2a, 3d, 3f, 3h, 5a

Lower Costs:

This project uses PV generation integrated with BESS to manage energy use through load shifting and solar PV self-consumption. The integration of proposed energy management system components will reduce peak energy demand by shifting building and community loads. The reduction of peak energy use will reduce the costs to procure additional energy during periods of peak demand and lower consumer's energy bills. For example, the project site, a low-income/affordable housing facility, is estimated to receive an energy cost savings of $262,800 and a peak demand charge reduction of $190,507 over a ten-year period. These savings will transfer to tenants as an electricity bill reduction.

Greater Reliability:

This project uses PV generation integrated with BESS to manage energy use through load shifting, emergency back-up, demand response, and ancillary grid services. The integration of proposed EMS components will reduce peak energy demand by using a BESS to shift building and community loads. The project is scalable in both size and quantity. Therefore, this effort will demonstrate the commercial feasibility to deploy many MWh of dispatchable energy integrated in a PV/BESS configuration with smart inverters.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$332,995
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$2,110,657	$75,374
Match Partner and Funding Split:	**Match Funding:**
LINC Housing Corporation: $80,000 (3.2 %) Regents of the University of California, Riverside Campus: $265,259 (10.5 %) EnSync Energy Systems: $46,750 (1.9 %) EnerBlü: $19,500 (0.8 %)	$411,509

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<table>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Agreement has been placed on a stop work order while the City of Long Beach is reviewing LINC Housing's building permit application. Once a building permit has been approved by the City, the stop work order may be lifted. LINC Housing anticipates their building permit application being approved by January 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration

[EPC-16-079]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/30/2017 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S6: Advance the Use of Smart Inverters as a Tool to Manage Areas with High Penetrations of PV.

Issue:

California Rule 21 was revised to include autonomous device control, data communication, and dynamic electrical control functions for smart inverters. A number of additional functions with the potential to substantially increase the grid's solar hosting capacity are deferred to the third phase, the timeline for which is uncertain. Phase III includes advanced functions that affect the real power produced by solar PV systems. There are both technical and economic questions that must be answered before these capabilities are to come into use. Questions persist regarding practical approaches for compensating PV owners for the lost energy value when active-power exports to the grid are curtailed.

Project Description:

This project will comprehensively evaluate the Phase III functions. The process will include computer modeling of California distribution circuits for economic analysis, implementation of Phase III functions in multiple inverter brands, laboratory testing, and field pilot testing. An economic analysis will build on the technical findings from the computer modeling, identifying the impact to the asset owner, performing an economic valuation of these impacts, and providing guidance regarding potential compensation. A comprehensive cyber security assessment of the communication system will be performed and public key infrastructure will be established to support the cyber security needs in California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will help overcome three major barriers to achieving the state's energy goals by: 1) proving that CA Rule 21 Phase III functions can be deployed feasibly, safely and predictably via standardization; 2) demonstrating that grid penetration levels can be increased by 25% or more via use of the Phase III advanced control functions; and 3)

<table>
<tr><td colspan="2">enabling secure, scalable and affordable cyber security infrastructure that can make the grid safer and more reliable.</td></tr>
<tr><td colspan="2">CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Smart Inverter: D.14-12-035 (in R.11-09-011)</td></tr>
<tr><td colspan="2">Applicable Metrics: CPUC Metrics- 1a, 1b, 5a, 5b, 5f, 5g

Greater Reliability:

This project delivers standardized DER control functions that minimize and mitigate reverse power flows, voltage sags/dips, and other conditions that degrade grid stability and DER performance, thus increasing grid reliability and increasing the availability of access to solar energy.

Increase Safety:

The standardized methodology for demonstrating compliance to Rule 21 Phase III requirements eliminates the variability implied by proprietary solutions and enables dynamic electrical control functions to be deployed safely at scale. The availability of cyber security best practices and a public key infrastructure ensures that common security pitfalls are avoided as compliant systems are deployed in the field.

Consumer Appeal:

The advanced functionality and increased security delivered by this project enable PV system owners to participate in emerging wholesale ancillary grid services markets and aggregation networks, thus diversifying the potential revenue sources available.</td></tr>
<tr><td>Assignment to Value Chain:

Grid Operations/Market Design</td><td>Total Budgeted Project Admin and Overhead Costs:

$0</td></tr>
<tr><td>EPIC Funds Encumbered:

$2,935,822</td><td>EPIC Funds Spent:

$312,940</td></tr>
<tr><td>Match Partner and Funding Split:

SunSpec Alliance: $177,502 (3.9 %)
Sunrun: $1,102,122 (24.0 %)
Electric Power Research Institute, Inc.: $379,453 (8.3 %)</td><td>Match Funding:

$1,659,077</td></tr>
</table>

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<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-16-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
In 2018, the project team completed all the distribution system modeling and tested the effectiveness of Phase III functions to increase hosting capacity by 25% on a diverse set of California distribution circuits. Many roadblocks were overcome including challenges encountered in recruiting industry vendors to implement Phase III functions within the project timeline. Two commercial inverter brands implemented Phase III functions and they are currently undergoing laboratory testing at The University of California, San Diego. The laboratory testing is a precursor to a field test planned at 50 residential locations to evaluate the IEEE 2030.5 communication protocol at the utility interface.</td></tr>
</table>

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Project Name:

Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions

[EPC-17-001]

Recipient/Contractor:

Taylor Engineering, LLC

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/31/2017 to 12/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Typically, energy upgrade efforts focus on equipment replacement, which often have high costs. Updating the controls for existing systems to operate more efficiently presents a prime opportunity to achieve cost-effective savings. However, the current upgrade model presents a barrier for building owners and operators to effectively scale installation of advanced controls due to high transaction costs and the need for custom analysis and programming. This project aims to demonstrate large-scale HVAC and lighting control upgrades across a portfolio of building types that achieve energy savings while reducing transaction costs.

Project Description:

This project optimizes and simplifies control upgrades (HVAC and lighting) to demonstrate energy savings while also improving occupant comfort by using automated fault detection and diagnostics, continuous commissioning, and advanced measurement and verification procedures. The team will use the results to develop recommendations for strategies, tools, and initiatives to address market barriers and promote large scale market adoption.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will help achieve the State's energy goals by scaling up the market adoption of control retrofits that result in significant energy savings in commercial buildings. The successful demonstration of scalable, plug-and-play integrated packages of HVAC and lighting controls will allow commercial building owners and operators to maximize energy savings across large portfolios of buildings while reducing transaction costs.

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<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h
Lower Costs:
Deploying a simplified approach to achieving sustained operational savings of HVAC and lighting can reduce costs for building owners and operators and has the potential to increase market adoption. In addition, integrating measures into single installations can yield upwards of 20% energy savings and can reduce overall project costs and payback periods.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$932,257</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,966,716</td><td colspan="2">EPIC Funds Spent:
$546,900</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Kaiser Permanente Medical Center: $2,300,000 (40.1 %)
Enlighted Inc.: $246,750 (4.3 %)
KGS Buildings: $25,000 (0.4 %)
Delos: $57,000 (1.0 %)
Alerton: $15,000 (0.3 %)
Trane U.S., Inc.: $15,000 (0.3 %)
Automated Logic Corporation: $30,000 (0.5 %)
Siemens Corporation, Corporate Technology: $10,000 (0.2 %)
United States Department of Energy: $75,000 (1.3 %)</td><td colspan="2">Match Funding:
$2,773,750</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 2: 13 out of 15 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
</table>

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Progress this year includes securing four test sites, getting stakeholder feedback through technical advisory meetings, conducting pre-installation work, and initiating field installations. The project team is also actively planning market transformation activities to promote large scale market adoption once the technologies have been successfully demonstrated.

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Project Name: Scaling Solar+ for Small and Medium Commercial Buildings [EPC-17-002]	
Recipient/Contractor: Humboldt State University Sponsored Programs Foundation	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 9/17/2017 to 6/30/2020
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.	
Issue: Although a range of distributed energy resources (DER) and storage are being designed to power and support the fast changing electric grid, these DER are often procured separately. Without coordination between them, there are missed opportunities to reduce the soft costs of deployment and better support bulk power and distribution system operations. Integration technology elements appropriate for small-to-medium sized commercial buildings (SMB) are not commercially available, making it too costly to effectively deploy smart, integrated DER. This project addresses these challenges by developing standardized components for a Solar+ system designed specifically for the SMB sector.	
Project Description: The research team is designing, implementing, operating, and evaluating a Solar+ system in a pilot scale application for convenience stores. The project is designed to innovate across three key priority areas necessary for technology scale-up: hardware design guidelines, integration software, and site targeting. Filling these knowledge gaps will help move the deployment of Solar+ technologies forward, thereby bringing substantial benefit to individual building owners, as well as opening opportunities to provide service to the broader distribution and bulk power systems. This project focuses on the convenience store/fueling station SMB sector, but lessons learned and products developed can likely be extrapolated to other SMB sectors.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will integrate DER, energy storage, and controllable loads to increase the value of Solar+ systems in the SMB sector. Optimized relative sizing of batteries to PV and flexible operations from model-predictive control (MPC)-enabled building automation will demonstrate how investment in an integrated system can save costs and create efficiency compared to standalone PV and storage. The project will develop and demonstrate an open-	

source MPC algorithm with hierarchical control awareness of embedded, distributed control logic to manage building systems and improve load control. Improved hardware-software interfaces will integrate the solar PV system with localized energy storage and MPC-improved load control systems. This will allow SMB owners to optimize the benefits of distributed solar and approach net-zero energy buildings while also supporting the larger grid power system.

CPUC Proceedings addressing issues related to this EPIC project:

Self-Generation Incentive Program: R.12-11-005 Energy storage: R.15-03-011 [Closed] Distribution Resources Plans (AB 327): R.14-08-013 Smart Inverter: D.14-12-035 (in R.11-09-011) Demand Response (DR): R.13-09-011 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1c, 1e, 1f, 1h, 1i, 2a, 3d, 3h, 5a, 5f

Lower Costs:

This project will reduce onsite energy demands and peak loads, resulting in customer bill savings. For example, the estimated site benefits include energy and demand charge savings of $0.20 per watt of PV per year, along with payments for demand response for the distribution system and build power system of $0.20 per watt of PV per year. Without a coordinated effort to install solar + storage as a package, the commercial cost of such systems would be about $9 per watt of PV. This project will develop hardware design guidelines, integration software, and a site targeting toolkit to reduce the costs of installing solar PV, battery energy storage, and smart inverter equipment by about 33%.

Greater Reliability:

This project will expand the ability to provide power for critical services (e.g., fuel dispensing and refrigeration loads) in times of emergency when the utility grid is disabled (e.g. after a natural disaster). These project benefits will accrue both to the site host and to the local distribution grid. However, the greatest benefits from the project will likely come from amplification effects through the improved ability to promote smart deployment of Solar+ systems at scale throughout California.

Environmental Benefits:

Preliminary calculations indicate significant distributed energy resource capacity could be deployed through the framework and systems this project is developing. On first order, if each of the 12,000 convenience stores in California were to install or procure the equivalent of 50 kW in PV capacity, this would result in 600 MW of additional statewide capacity that generates 880 GWh annually. If there were no commensurate reduction in the RPS compliance requirements (because the generation would be behind the meter) this would represent accelerated progress on GHG reduction and save 300,000 tonnes CO2e per year.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$413,443

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<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,500,000</td><td colspan="2">EPIC Funds Spent:
$410,568</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Humboldt State University Sponsored Programs Foundation: $41,577 (2.3 %)
Serraga Energy, LLC at Blue Lake Rancheria: $258,665 (14.0 %)
Tesla Motors, Inc.: $25,000 (1.4 %)
Southern California Edison: $20,000 (1.1 %)</td><td colspan="2">Match Funding:
$345,242</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
As of November 2018, the solar PV panel array has been fully installed on the gas station canopy. LBNL is currently developing the Model Predictive Controller and testing for this control software will begin soon. The switchgear will be delivered early 2019 and the Tesla battery is scheduled to be delivered by March 2019. The complete solar + storage system is planned to be fully commissioned by May 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Developing a Comprehensive, System-Wide Forecasting to Support High-Penetration Solar [EPC-17-003]

Recipient/Contractor:

Clean Power Research, L.L.C.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	9/1/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

California experiences a wide range of meteorological phenomena, including coastal and valley fog, monsoon events, and temperature inversion/smog events. These phenomena impact the reliability of both satellite-based and Numerical Weather Prediction (NWP) forecast models due to the challenge of predicting cloud formation/dissipation during these conditions. This weather-based uncertainty translates into PV simulation uncertainty in which electric grid operators increasingly rely upon forecast of PV production in their dispatch of operating resources. When forecasting aggregated PV production of many systems, the variability of output due to cloud transients results in forecast uncertainty.

Project Description:

This project provides CAISO with an improved next-minute to day-ahead high resolution, system-wide, probabilistic power production forecast for all California PV systems. The comprehensive forecast includes both behind-the-meter and utility-scale PV systems. The project is quantifying the costs and benefits of these improvements. The team uses mid-term DER adoption forecasts adapted from the IOUs' DRPs to project distribution of DERs into the future. The team is combining the result with the improved PV forecast to integrate results into CAISO load forecasts using Itron's load forecast engine.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project advances the state of PV forecasting in California by improving the accuracy of solar irradiance and PV forecasts, particularly rooftop solar, which is not currently well-understood. Participants in the Energy Commission's January 2017 forecasting workshop identified the lack of visibility into DER impacts on net load as a major barrier to generating accurate forecasts. Forecast inaccuracies cost California millions of dollars annually and result in the unnecessary curtailment of renewable generation.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 2a, 3a, 5c

Lower Costs:

A reduction of 57 MW in spinning reserves required to accommodate day-ahead forecast errors for the existing PV fleet across CAISO reflects a 28.7 percent reduction (versus persistence) in the root means square error of day-ahead forecasts. Assuming the average price of spinning reserves at CAISO is $10.11/MW, such an increase in forecast accuracy reflects savings of roughly $5 million per year for California. Previous studies have shown that these reserve savings only constitute 5-10 percent of total savings from improved economic dispatch and unit commitment. If this is the case, savings for California from such an improvement in accuracy are on the order of $50 million per year.

Greater Reliability:

This project will integrate an improved PV production forecast into CAISO operations, increasing electric power system reliability across California. The uncertainty of PV generation imparts costs to the California ratepayer, because the CAISO must carry spinning and non-spinning reserve resources to accommodate this uncertainty. Reducing uncertainty reduces required reserves. This project will quantify reductions in reserve requirements. Further, the project will provide knowledge to the grid operator and California decision-makers to help the state plan for increased adoption of DERs while maintaining reliability standards by examining the impacts of DER adoption on forecast accuracy.

Environmental Benefits:

Assume that the deferred reserves correspond (from an environmental standpoint) to the average California energy mix. The CEC references 0.73 lbs of CO2 per kWh as the average carbon footprint reflecting the energy mix in California. Therefore, the increased forecasts defer 57 MW of reserves for the entire year for a day-ahead forecast RMSE improvement of 28.7 percent versus baseline. This corresponds to roughly 500 GWh of displaced electricity. The corresponding environmental impact is roughly 166,000 Teq (Tons-equivalent) of CO2 using the emissions factors of 0.331 kg/kWh CO2.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$176,606
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$750,000	$323,524

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<table>
<tr><td colspan="2">Match Partner and Funding Split:
State University of New York at Albany: $20,000 (1.9 %)
Clean Power Research, L.L.C.: $300,000 (28.0 %)</td><td colspan="2">Match Funding:
$320,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 5: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The first Critical Project Review meeting was held on August 28, 2018. Since then, Energy Commission staff has reviewed and approved the final reports for the PV Forecast Accuracy Improvement and the DER Production Database tasks. Energy Commission staff is coordinating with staff from CPUC and the California Solar Initiative DG Stats website to post the DER Production Database data and report in a way that will provide the greatest visibility to the data and allow it to be used by others.

CPR has also submitted the draft reports for the Irradiance Forecast Accuracy Improvement and the CAISO Integration Report tasks. CPR anticipates completing both of these final reports by December 2018.

CPR anticipates completing the draft reports for the Time-Dependent Forecast Error Valuation Methodology and the DER Adoption Forecast Impact tasks in the first quarter of 2019.</td></tr>
</table>

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Project Name: Enhanced Modeling Tools to Maximize Solar + Storage Benefits [EPC-17-004]	
Recipient/Contractor: Energy and Environmental Economics, Inc. (E3)	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 9/18/2017 to 3/31/2020
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.	
Issue: Customer adoption of PV and storage and other DER is set to substantially increase in California as technology costs decrease, new products are brought to market, and the relationship between customer and utility evolves. DER could have very different costs to ratepayers depending on how customers are incentivized to use them. If the incentivized use of DER by customers through their tariffs or programs is not aligned with the needs of the grid, DER adoptions could be very costly.	
Project Description: This research is developing a solar + storage optimization tool to evaluate the dispatch, operations, and value proposition for integrated solar + storage systems. The tool is capable of evaluating distributed solar with storage and an array of advanced controls and dispatchable DER technologies, and it evaluates optimal dispatch for a wide range of customer programs and incentives. The tool is currently being used to evaluate the EPIC funded solar + storage systems awarded under the Solar + solicitation. It's also designed to integrate into the California Public Utility Commission (CPUC) Distributed Resource Planning (DRP) process with discussions on utilizing this in the Distribution Investment Deferral Framework (DIDF) which require the IOUs to issue the Distribution Deferral Opportunities Report (DDOR) to be vetted by the Distribution Planning Advisory Group (DPAG) to identify candidate projects that should be issued for competitive solicitation.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project is developing a tool, in consultation with the three large IOUs, that will enhance the existing Local Net Benefits Analysis (LNBA) tool developed by the Recipient under the CPUC's DRP. It's capable of simulating the operations of DER under different tariff and program designs and determining the new designs that align the best uses of DER to the	

customer with the best uses of DER for the grid that will maximize the benefits of DER to ratepayers. The current planning tools do not consider how different tariff and program designs will affect DER locations and adoption rates that will affect system reliability and cost. There are discussions on utilizing this tool in the DIDF process to target the cost-effective DER to those locations that provide the highest utility and ratepayer benefits.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 2a, 3b

Lower Costs:

$420 million in distribution capital expenditures are driven by peak load growth and are potentially deferrable by targeted deployment of DER. Assuming deferral of 10% of those costs ($42 million) for 3 years and a utility WACC of 7.9%, the cost reduction for ratepayers is $9 million for 2017 and $34 million over 5 years. The project will enable DER deployment targeted to areas with highest deferral value. Conservatively estimating that this doubles the deferral value (e.g. from $50 to $100/kW-Yr.) for 5% of the deferral opportunities, the annual ratepayer savings are $21 million.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $457,030
EPIC Funds Encumbered: $987,379	**EPIC Funds Spent:** $624,005
Match Partner and Funding Split: Southern California Edison: $50,000 (4.6 %) San Diego Gas & Electric Company: $50,000 (4.6 %) Energy and Environmental Economics, Inc. (E3): $8,655 (0.8 %) Starboard Energy Advisors, LLC: $35,000 (3.2 %)	**Match Funding:** $108,655
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 31 out of 35 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: E3 has submitted four iterations (as planned) of the Solar + Storage Tool, with each iteration incorporating feedback and comments from TAC Members. E3 has also hosted multiple meetings, has provided a walkthrough of Tool functionalities, and is collaborating with the recipients of three EPIC agreements (16-070, 16-073 and 17-002) on collecting data and demonstrating the Tool in various use cases. The final version of the Tool is anticipated for completion by March 2019 and will incorporate additional feedback from TAC Members and the "lessons learned" from the three EPIC agreements listed. E3 has proposed multiple public workshops and webinars, with the first anticipated in March 2019, to demonstrate how the Solar + Storage Tool can provide a robust, regulatory grade cost-benefit analysis of DER programs and also how it can influence the design of DER programs to maximize net benefits.

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Project Name:

Integrating Building-Scale Solar + Storage Advanced Technologies Maximizing Value to Customer and the Distribution Grid

[EPC-17-005]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	12/13/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Regulatory and economic factors in California have created accelerated penetration of rooftop photovoltaic (PV) in the small commercial segment, benefitting facility managers in energy savings while helping to achieve California's renewable goals. However, uncontrolled and uncoordinated renewable generation creates issues with stability and reliability of the distribution grid. Given that implementation of PV, Storage, and Energy Efficiency /Energy Management Systems (EMS) technologies is typically siloed, cumulative benefits are difficult to realize. An integrated Distributed Energy Resource (DER) management approach is needed to balance commercial customer and grid requirements.

Project Description:

This project assesses the performance and benefits of integrated solar photovoltaic and storage along with advanced energy efficiency and demand response / distributed energy resources management technologies in a commercial building setting. The goal is to leverage the synergies of integrated and controllable components to improve distribution grid stability and reliability while also enabling the commercial customer to reduce both capital costs and operational and management costs for optimal value.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

" sizzle1544571730991="">For California to achieve its long term greenhouse gas reduction goals, there is a greater need for flexibility at all levels of grid operations. This project will demonstrate a suite of DER technologies, including solar + storage, with the capability for active and reliable control of customer owned loads and resources in order to a) reduce the building owner's energy bill and b) reduce the need to build new transmission and distribution infrastructure that is typically required to compensate for high loads and customer-side generation.

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CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed] Distribution Resources Plans (AB 327): R.14-08-013 Net energy metering: R.14-07-002 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1h

Lower Costs:

Synergistic integration with storage further reduces grid stress and expensive peak generation at ramp-up time, improves distribution capacity utilization, and reduces stress to prolong asset life and reduce costs of distribution system upgrades. Total lifecycle cost (capital cost, installation, O&M) for behind the meter solar + storage system is expected to be reduced by up to 10% through energy system integration.

Greater Reliability:

This project reduces distribution system stress through better dispatchability and improves management of both over-generation and 'ramp-up' periods through flexible load and storage management.

Environmental Benefits:

Solar generation helps reduce greenhouse gas and air emissions associated with grid power, particular when off-setting peak power.

Consumer Appeal:

Better integration of customer preferences and operational priorities with grid preferences. Cost-effective implementation reduces both acquisition costs and O&M costs.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $360,079
EPIC Funds Encumbered: $1,491,764	**EPIC Funds Spent:** $92,693
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $271,090 (15.4 %)	**Match Funding:** $271,090
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	31 out of 35 bidders	Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Patent application for novel daylighting panels. Smart Software Algorithms to charge Electric Vehicles from the grid or battery system based on time of day and utility rates. Smart software algorithms to monitor, control and visualize energy and power flows from renewable power sources, distributed energy storage system and other grid generation and transmission assets.

Update:

The Energy Commission is currently processing a site change amendment. The original site, a wholesale coffee roasting warehouse in Oakland, was not suited to fully demonstrate all of EPRI's planned technology, and the owner backed out of the agreement. The amendment will move the project site to the San Francisco Bay Area Council (SFBAC) of the Boy Scouts of America, located in a disadvantaged community in San Leandro, CA. The new site has a commercial building load profile that varies between weekday load and weekend load. This will demonstrate the flexibility of Intech's building controller. At this new site, EPRI will be able to fully demonstrate all the technologies captured in their project agreement.

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Project Name: Development, Implementation, and Integration of a Holistic Solar Forecasting System for California [EPC-17-006]	
Recipient/Contractor: Electric Power Research Institute, Inc.	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 10/5/2017 to 6/28/2020
Program Area and Strategic Objective: Applied Research and Development S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.	
Issue: Successful integration of renewable resources into power system operations will require the ability to forecast the output of these resources in timeframes from less than an hour to days ahead. Fog and stratus affect solar irradiance in California throughout the year, and shortcomings in predicting fog and stratus dissipation currently constrain the accuracy and confidence of short-term solar irradiance forecasts. The value of using improved forecasts is still not well understood by grid operators and utilities due to the difficulty of assessing return on investment for an improved forecasting system particularly for deploying instruments to improve the data used in forecasting models.	
Project Description: The project develops an improved forecasting system for solar irradiance in California, with a particular focus on fog and stratus conditions, through targeted deployment of instrumentation. The improved forecasts will be integrated into operational tools for use by the California Independent System Operator (CAISO) and utilities. This project utilizes a targeted instrumentation network, consisting of existing and new sensors, to improve the models used for forecasting fog and stratus conditions. The Recipient will design and deploy this network with the aim of improving the forecasts that are most important to CAISO and/or utility operations.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The use of an advanced network of existing and new instrumentation to inform numerical weather and statistical model improvements will significantly improve the current state of solar forecast modeling in California. The holistic forecasts produced will showcase a combination of various aspects of the weather forecast value chain, not previously	

demonstrated, linking observation systems and advanced physical and statistical modeling for solar forecasting. The project's focus on fog and marine layer forecasts, which are traditionally challenging to predict, assures that these issues are well-understood in advance of increased PV penetration in the coming years.
CPUC Proceedings addressing issues related to this EPIC project: Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003
Applicable Metrics: CPUC Metrics- 1b, 2a Lower Costs: Improved forecasts help to reduce operating costs by improved commitment and dispatch of generating resources, reductions in solar power curtailment, and more optimal procurement of resources for IOUs. Greater Reliability: Improved forecasts support the advancement of reliability of renewable energy by reducing uncertainty that the Investor Owned Utilities (IOUs) and CAISO are exposed to, and therefore ensuring supply/demand balance across the CAISO system, improved voltage control on distribution systems and ensuring that utilities can perform transmission and distribution switching. Increase Safety: Improved forecasts can ensure that reliability and safety is maintained at the distribution and transmission level. This can also help improve switching operations required for successful Distributed Energy Resource Management System (DERMS) integration into operations, and can provide input into decisions made for various new smart grid devices, such as the use of smart inverters for voltage optimization and the use of energy storage in distribution and transmission operations. Utility procurement can also be significantly improved by improved forecasting of solar PV output and load. Economic Development: Improved forecasts of marine layer and fog conditions has the potential to, among other things, improve the efficiency of generation dispatch, reduce the need for operating reserves to manage forecast error and maintain or increase reliability while integrating increased levels of renewables. A uniform improvement of 20% for day-ahead and four-hour-ahead forecast horizons can reduce system wide production costs by up to 0.4%, at penetration levels of approximately 20% energy.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Grid Operations/Market Design	$365,395

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$749,740</td><td colspan="2">EPIC Funds Spent:
$30,785</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
AWS Truepower, LLC: $177,229 (16.5 %)
Sonoma Technology, Inc.: $83,000 (7.7 %)
Electric Power Research Institute, Inc.: $64,601 (6.0 %)</td><td colspan="2">Match Funding:
$324,830</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
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Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 5: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Researchers are collecting real-time data from instrumentation at all project sites, which is posted every 30 minutes on a real-time website developed to support the field measurement program. The website provides an interface for visualizing, reviewing, and quality-assuring sensor data. The team has set up and performed a series of experiments using the WRF (Weather Research and Forecasting) numerical weather prediction model to test the sensitivity of the model's ability to forecast foggy conditions. Researchers also developed a code to convert observations from a network of meteorological sensors into a format that is readable by the WRF Data Assimilation module to allow the measurements to improved forecasts of fog and low clouds that affect day-ahead and other short-term solar generation forecasts for electric utilities and grid operators.</td></tr>
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Project Name: Integrated Community Solar and Storage at a Low Income Mobile Home Park [EPC-17-007]	
Recipient/Contractor: Center for Sustainable Energy	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 7/13/2017 to 12/31/2020
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.	
Issue: Distributed solar photovoltaic (PV) systems will continue to be deployed to meet California's GHG reduction and renewable energy goals, but daytime grid oversupply and meeting evening demand must be addressed to provide stable, reliable generation. Energy storage can help to shift PV generation from mid-day to evening peak, but rates do not incentivize mid-day storage charging periods. Residential customers do not profit from reducing their peak demand, and energy storage installations are often based on unclear end customer value propositions. Adding storage to existing solar PV installations requires duplication of permitting, installation, and commissioning efforts and costs.	
Project Description: The Center for Sustainable Energy (CSE) is applying high efficiency solar and storage technologies to create an integrated community solar and storage energy system at a low income mobile home park in Bakersfield, California. The project illuminates operational strategies for storage to provide clear value propositions to end-use customers with existing tariff structures and demonstrate alternate structures and additional value streams that can increase the value of storage to the end customer while better achieving distribution system operational goals.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project is designing, installing, and evaluating integrated high-efficiency solar panels with energy storage batteries, along with low-cost control hardware to demonstrate the impact of an integrated community solar and energy storage system in a low-income community. The project is designed to demonstrate the impact of an integrated community solar and energy storage system in a low-income community, which is expected to reduce net energy consumption and reduce energy bills.	

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CPUC Proceedings addressing issues related to this EPIC project:

Net energy metering: R.14-07-002 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 3h

Lower Costs:

The primary application of the solar PV and energy storage system will be to lower energy costs, by approximately 37%, for the individual tenants within the mobile home park. Additionally, by providing potential locational benefits such as reducing congestion on the distribution feeder or increasing the integration capacity of the circuit, the grid will function more efficiently, potentially deferring or offsetting grid transformer or line upgrades. Shifting excess solar PV generation from the middle of the day to evening residential peak hours will reduce the need to deploy more expensive peaker plants.

Greater Reliability:

The project is strategically sited in a distribution area identified by PG&E for needing capacity upgrades due to potential thermal overloads and voltage concerns. Storage integrated with solar PV on the distribution system can increase system reliability through services such as local overload relief, renewable integration on circuits with high penetration of intermittent generation, and local customer back-up.

Environmental Benefits:

The project could lead to reductions in greenhouse gas and air pollutant emissions through reduced energy consumption and generation. Deployed at 5% of mobile home and multifamily dwellings across the state by 2025, community-scale solar PV and energy storage operated as proposed could reduce annual energy generation needs, including peak-demand, by 800 MWh. This reduced energy consumption would result in an estimated reduction of roughly 505,000 metric tons of CO2 annually, with concurrent reductions in both NOx (criteria pollutant) and methane (GHG) emissions.

Consumer Appeal:

The integrated suite of solar PV, energy storage, and smart controls is anticipated to reduce annual energy usage by 32%, bringing total utility bills down by approximately 37%, which is substantial considering change to TOU billing and the energy discounts the park already receives through the California Alternate Rates for Energy (CARE) program. The same configuration and use cases piloted in this project could be replicated at other multifamily dwellings as well.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Grid Operations/Market Design	$499,016

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<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,005,923</td><td colspan="2">EPIC Funds Spent:
$35,805</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Resident Owned Parks, Inc.: $340,905 (14.5 %)</td><td colspan="2">Match Funding:
$340,905</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
31 out of 35 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Grantee has identified the following as pre-existing project relevant IP:

1) Center for Sustainable Energy Name and Logo
2) Horizon Solar Power Logo
3) Kisensum Energy Storage Control Software</td></tr>
<tr><td colspan="4">Update:
The kickoff meeting was held on January 31, 2018. In June, CSE discovered Horizon Solar Power (subcontractor) did not budget for paying its workers prevailing wage. In July 2018, this project was placed under stop work order until CSE finds a replacement subcontractor. Before being placed under stop work order, subcontractor Kisensum had begun to prototype the optimization algorithm necessary to manage the onsite storage and develop unit tests for Tesla battery controls.</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Empowering Energy Efficiency in Existing Big-Box Retail/ Grocery Stores

[EPC-17-008]

Recipient/Contractor:

Center for Sustainable Energy

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	8/1/2017 to 1/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

California Senate Bill 350 aims to double statewide electricity and gas end use savings from energy efficiency (EE) and conservation measures by 2030. This is equivalent to a 20% reduction in projected statewide building energy use. Meeting this aggressive target will require the commercial building industry to install holistic energy efficiency technology packages, specifically those that leverage, emerging, pre-commercial products. According to the 2013 Navigant California Potential and Goals Study, aging, existing commercial buildings, particularly in inland communities, present the greatest energy savings potential.

Project Description:

This project demonstrates the impact of an integrated suite of pre-commercial energy efficiency technologies in a large, existing, retail building located near a disadvantaged community. One of the technologies that comprise the installation package includes a novel supervisory controller to provide system-wide optimization, to reduce electricity consumption across numerous building subsystems, including lighting, refrigeration, and heating, ventilation, and air-conditioning (HVAC). This could enable site electricity savings of greater than 20%.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project demonstrates how pre-commercial energy efficient technologies can deliver cost-effective, deep electric savings in a big-box retail environment, while also showcasing the demand reduction potential of these strategies. To overcome barriers associated with the package, the team resolves and documents identified system integration and operational challenges. Additionally, rigorous M&V and extensive energy modeling quantifies beneficial technology synergies.

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CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1f, 1h, 2a, 3a, 4c

Lower Costs:

The project could result in lowering on-site electricity use by 20 percent.

Greater Reliability:

The project adds valuable capacity to California's electrical transmission and distribution system. The project includes significant focus on reducing the power consumption of packaged HVAC systems which are disproportionately responsible for critical capacity shortfalls. The DR resources will provide efforts to integrate variable renewable resources into the electric grid to minimize impacts that destabilize the reliability of the system.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $686,589
EPIC Funds Encumbered: $2,824,685	**EPIC Funds Spent:** $247,899
Match Partner and Funding Split: Walmart: $250,000 (7.0 %) Southern California Edison: $100,000 (2.8 %) Robert Bosch LLC: $248,400 (6.9 %) Software Motor Corporation: $62,704 (1.7 %) Apana, Inc.: $10,080 (0.3 %) SmartGreen: $59,800 (1.7 %) Transformative Wave: $17,000 (0.5 %) Integrated Comfort: $12,000 (0.3 %)	**Match Funding:** $759,984
Leverage Contributors:	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 2: 13 out of 15 bidders	**Rank of Selected Applicant/ Bidder:** Phase 2: Ranked # 3

APPENDIX B:
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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The team has completed baseline monitoring and pre-installation characterizations for the site. In 2019, the team will model and install efficient retrofit packages at the site which include LED lighting, HVAC, and refrigeration upgrades.

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Project Name: Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California) [EPC-17-009]	
Recipient/Contractor: Willdan Energy Solutions	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 8/1/2017 to 3/28/2021
Program Area and Strategic Objective: Technology Demonstration and Deployment S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.	
Issue: Much of California's existing buildings stock is old and high-energy consuming. An estimated 50% of the state's existing buildings were built before California's Building Energy Efficiency Standards went into effect in 1978. Commercial facilities consume 37% of the state's electricity, more than any other sector. Yet there remains significant energy reduction potential for this sector. Adoption of comprehensive energy efficiency packages has been limited. Market barriers such as lack of stakeholder knowledge, fear of early adoption, and the high cost of emerging technologies means significant energy savings opportunities remain.	
Project Description: This project demonstrates three innovative bundles of pre-commercial technologies. The technology bundles were strategically developed through a systems-level approach to address the most energy-intensive areas in commercial buildings. These include: (1) Chilled Water Plants: Optimized all-variable-speed chilled-water (CHW) plants utilizing alternative refrigerant chillers. (2) Office and Exterior Space LED fixtures with integrated advanced controls, advanced building management system (BMS), and plug load controls controllable for demand response (DR), and off-grid, exterior, LED lighting in the parking lot, and lastly (3) Advanced laboratory ventilation, fume hood exhaust, and direct current (DC) lighting systems.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The demonstration project offers an innovative approach applicable to a range of commercial buildings. This strategy will accelerate adoption of energy savings technologies, contributing to reaching the state's energy efficiency and GHG reduction goals. By demonstrating this comprehensive approach in a real-world application this research has the potential to lead to	

further scale up and adoption of similar technology packages in other government and commercial buildings.
CPUC Proceedings addressing issues related to this EPIC project: Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]
Applicable Metrics: CPUC Metrics- 1f, 1h, 3b Lower Costs: Energy savings achieved through implementation of these technologies could generate cost savings for building owners and operators. It is projected that these technologies will save an estimated 20% of building energy consumption. Future adopters will benefit from lower costs associated with economies of scale as production increases. Economic Development: Large-scale adoption of these technologies will promote industry growth through increased manufacturing and construction, spurring new growth and leading to further investment in research and development of additional new technologies. Environmental Benefits: In addition to GHG emission (CO2) reductions associated with the energy savings of the project, the project includes chillers that utilize low global warming potential (GWP) alternative refrigerant that contain no stratospheric ozone depletion compounds. These refrigerants are in alignment with the Montreal Protocol Kigali Agreement to phase out high GWP refrigerants. It also supports the California Air Resources Board target to reduce short lived climate pollutants.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $875,037
EPIC Funds Encumbered: $3,994,256	**EPIC Funds Spent:** $182,447
Match Partner and Funding Split: ASWB Engineering: $5,330 (0.1 %) Aris Wind: $33,250 (0.5 %) Trane U.S., Inc.: $50,000 (0.8 %) Willdan Energy Solutions: $2,293,645 (36.0 %)	**Match Funding:** $2,382,225

APPENDIX B:
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<table>
<tr><td colspan="2">Leverage Contributors:

N/A</td><td colspan="2">Leveraged Funds:

$0</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

phase 2: 13 out of 15 bidders</td><td>Rank of Selected Applicant/ Bidder:

Phase 2: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:

The team recently completed the measurement and verification plan and the engineering design of the various energy efficiency packages. The first phase of the project, a retrofit of the HVAC chiller system, is set to begin in early 2019.</td></tr>
</table>

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Project Name: Integrated Heat and Moisture Calculation Tool for Building Envelopes [EPC-17-010]	
Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 8/14/2017 to 12/1/2020
Program Area and Strategic Objective: Applied Research and Development S11: Provide Federal Cost Share for Applied Research Awards.	
Issue: Moisture can degrade both the durability and thermal performance of buildings. This project designs software to identify thermal and moisture interactions during building envelope design.	
Project Description: The project is developing processes and supporting software to enable more efficient building operations and reduce costs. The goal is to develop a set of tools that can be integrated with EnergyPlus/OpenStudio or similar design tools. The tools will enable design engineers to use energy-efficient ASHRAE-developed or custom control sequences for commercial buildings and verify their correct implementation. The project is expected to reduce the time to specify, implement and verify the proper operation of control sequences.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The cost-effective modeling tool will enable improved envelope designs for new construction and retrofit applications, thus increasing building energy efficiency. As this project is jointly funded with the US Department of Energy, the developed tools have the potential to be broadly disseminated which could further the advancement of the developed software	
CPUC Proceedings addressing issues related to this EPIC project: Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]	

APPENDIX B:
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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 1h
Lower Costs:
The software tool could increase building envelope energy efficiency and reduce HVAC energy use by 5%.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$59,000</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$125,000</td><td colspan="2">EPIC Funds Spent:
$25,000</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
U.S. Department of Energy</td><td colspan="2">Leveraged Funds:
$1,375,175</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
43 bidders</td><td>Rank of Selected Applicant/ Bidder:
N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The team is currently testing the tool and receiving feedback from a group of reviewers using an alpha version of the software. The recipient has completed a detailed data management plan. The DOE’s quarterly assessments show the project is generally on track, there are no major concerns, and the project continues to hold strong promise</td></tr>
</table>

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Project Name: Demonstration of an Innovative, Community-Scale, Organic Waste-to-Energy Facility [EPC-17-011]	
Recipient/Contractor: HZIU Kompogas SLO Inc.	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 8/9/2017 to 9/30/2019
Program Area and Strategic Objective: Technology Demonstration and Deployment S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.	
Issue: Newly adopted state goals have called for increased production of renewable energy, increased waste diversion from landfills, and a reduction of short lived climate pollutant emissions. Increased deployment of anaerobic digester systems can help meet all of these goals by producing renewable energy, diverting organic waste from landfills, and reducing associated short lived climate pollutant emissions. However, anaerobic digester systems tend to be logistically complicated, technologically complex, and prohibitively expensive. There is a need to demonstrate and deploy cost-effective anaerobic digester systems in local communities.	
Project Description: The goal of the project is to construct and demonstrate operation of an innovative, state-of-the-art anaerobic digestion facility converting organic waste from San Luis Obispo County into renewable electricity. The facility is the first of its kind of dry digester technology to be installed in the U.S. and is expected to process about 36,500 tons of food waste and urban waste into 6.2 million kWh per year of renewable electricity, 13,000 tons of compost and 1.6 million gallons of liquid fertilizer leading to a host of environmental (e.g. reduction of 5,300 MT CO2e per year), economic, reliability, and safety benefits.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will benefit California ratepayers by demonstrating an innovative, state-of-the-art anaerobic digester facility. Once economical operation is proven, similar facilities can be replicated across California to provide similar benefits to other local communities.	

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CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 2a, 3a, 3b, 3g, 3h, 4a

Lower Costs:

This project will demonstrate a cost-effective approach for utilities to meet their bioenergy mandates while also lowering the cost of bioenergy for electric ratepayers.

Greater Reliability:

This project will produce approximately 6.2 million kWh of renewable distributed generation annually, improving local system reliability and reducing the stress on the grid.

Environmental Benefits:

Diversion of organic waste from landfills will result in avoided methane and nitrous emissions, powerful short lived climate pollutants. The project team estimates the system will result in net annual greenhouse gas emission reductions of approximately 5,300 metric tons of carbon dioxide.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $4,000,000		**EPIC Funds Spent:** $292,517	
Match Partner and Funding Split: HZIU Kompogas SLO Inc.: $5,278,373 (56.9 %)		**Match Funding:** $5,278,373	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. This project will utilize the Hitachi Zosen Innova digester system originally developed in Japan.
Update: Construction of the anaerobic digester (AD) facility in San Luis Obispo has been completed in October 2018 and facility began taking green waste. First samples of biogas have been produced and cleaned using hydrogen sulfide (H2S) removal system that has been commissioned on site. H2S removal system allows to store biogas on site. A grand-opening ceremony was held on November 14, 2018. During the first quarter of 2019, the recipient will finalize the Source Testing Plan in collaboration with SLOAPCD allowing the facility to accept organic food waste. The combined heat and power unit is fully installed and ready to deliver electricity from combusted biogas to the grid, once the interconnection agreement with PG&E is fully executed, also expected during the first quarter of 2019.

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Project Name:

Biomass-to-Electricity: Pilot-Scale Testing of Baseload Compared to Flexible Power

[EPC-17-012]

Recipient/Contractor:

Taylor Energy

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	8/1/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

In 2016, the US Forest Service estimated there are over 102 million dead and dying trees in California's forests. This buildup of dry fuel increases the likelihood of large, unpredictable wildfires which have significant negative impacts to the environment, human health, and safety. Disposal of these dead and dying trees is necessary to mitigate wildfire risk, however, it is extremely expensive with little opportunity to recover the costs. Adoption of community-scale bioenergy systems can create a sink for forest wood waste while generating renewable electricity and local revenue. There is a need to identify technologies which can cost-effectively convert forest waste biomass to energy.

Project Description:

The project tests and evaluates three different energy pathways for conversion of woody biomass to electricity. The three pathways tested with the pilot-scale gasifier system are: 1) clean fuel gas production for baseload power generation, 2) syngas to Fischer-Tropsch liquid production for storage and flexible power generation, and 3) direct bio-crude production for storage and flexible power generation. Results from the three pathways will be compared and an optimal pathway will be identified for extended testing. After performing extended testing of the optimal pathway the technical, environmental, and economic performance of a full-scale facility will be evaluated.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will test and evaluate new biomass-to-energy pathways which is critical to meeting several of California's energy goals and provides numerous economic, environmental, and safety benefits to California ratepayers.

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CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]

Applicable Metrics: CPUC Metrics- 2a, 3a, 3b, 3e, 4a

Lower Costs:

The technology aims to significantly reduce the capital costs of biomass gasification systems, subsequently reducing the cost of renewable electricity generated. The technology is expected to provide at least 20 percent improvement in cost-effectiveness compared to existing systems and would be capable of delivering power at $0.118/kWh for a full-scale system.

Increase Safety:

Increased use of forest waste biomass can reduce the risk of catastrophic wildfires which can have major impacts on human health and safety.

Environmental Benefits:

The technology aims to produce significantly reduced criteria pollutant emissions compared to conventional biomass boiler generator systems, which will be quantified during the project. Compared to conventional natural gas power plants, this technology aims to reduce greenhouse gas emissions by 50 percent. In addition, increased utilization of forest-derived biomass may reduce wildfire rates which produce the majority of black carbon emissions in California.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $254,980	
EPIC Funds Encumbered: $1,499,000		**EPIC Funds Spent:** $868,228	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 56 out of 57	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 2

		bidders; phase 2: 23 out of 23 bidders	

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The technology employs "shockwave gasification". Shockwave Gasification employs pulse-detonation power to increase biomass gasification process intensity. The technology was developed, tested, and reduced to practice under a previous EISG grant program that compared gasification methodologies, using a pulse-deflagration method compared to a pulse-detonation method.

Update:

The project conducted its kickoff meeting in September 2017. The project team has completed initial system modifications and has performed testing of the first pathway - clean fuel gas production for baseload power generation. The project team is performing system modifications required for testing of the other two pathways.

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Project Name: Small Scale Forest Waste Power System [EPC-17-013]	
Recipient/Contractor: Altex Technologies Corporation	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 9/1/2017 to 4/30/2020
Program Area and Strategic Objective: Applied Research and Development S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.	
Issue: The risk of forest fires is very high in the semi-arid climate of California. Innovative management of woody biomass can reduce the serious risk of high severity forest fires. Forest waste material could be utilized as a renewable fuel resource to help California achieve its renewable portfolio standard goals. However, use of forest biomass for power production has been challenging due to high collection, pre-processing and transportation costs. One of the possible solutions is an operationally reliable and affordable modular biomass power plant that can utilize this abundant resource to produce cost effective and competitive renewable electricity.	
Project Description: This project develops a pilot-scale modular biomass power system called Altex Forest Power Technology (FORPOWER) that uses biomass from forest management as fuel to generate renewable electricity. FORPOWER, which is based on an indirectly fired gas turbine technology that separates the fuel combustion products from the clean gas turbine working fluid by using a novel heat exchanger, uses forest slash as a renewable fuel while meeting criteria pollutant requirements, reducing greenhouse gas emissions, supporting renewable energy goals, and improving forest sustainability. The Altex FORPOWER will cost effectively convert forest slash to electric power and interconnect with the grid at distributed locations within IOU regions that are close to forest resources.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Integrating a low cost feedstock densification approach and innovative heat exchanger with gasifer and externally fired gas turbine to efficiently generate electricity from forest slash will provide multiple benefits to California IOU electricity ratepayers including reduced power cost relative to alternative approaches and improved electric power generation reliability while	

reducing the risk of forest fires and pollutant emissions and creating economic development opportunity near the forest region.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

Applicable Metrics: CPUC Metrics- 1a, 2a

Lower Costs:

The Altex FORPOWER uses a low-cost forest slash densification approach (developed under PIER) that further reduces an already relatively low feedstock by 31% relative to conventional logistics; combining this approach with an externally fired turbine and innovative heat exchanger further lowers the cost of power by over 39% compared to a typical forest biomass gasifier coupled to an IC engine. Once scaled up to 3 MW and deployed, savings in fuel cost could range from $6 million for 10 units deployed.

Greater Reliability:

A successful distributed generation technology like FORPOWER will help improve system reliability once dispersed in different locations by distributing feed in of power to the grid at multiple locations thereby reducing loads on transmission lines and substations.

Economic Development:

Ten units of the scaled up system (at 30 MW of total capacity) could provide revenue of over $20 million per year from generated electricity. Revenue from the production of power from biomass power plant operation and sales of power plant units along with collection and transport of biomass will bring economic development near forests and create jobs. Researchers estimate that 10 units would create 90 direct jobs.

Environmental Benefits:

FORPOWER technology will help reduce fossil fuel use and the associated emissions of criteria pollutants and greenhouse gas. Assuming a 31% reduction in forest management costs and 50 units of the technology are deployed over 10 years, the reduction in GHG emissions could surpass one million tons per year.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$768,611

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<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,499,994</td><td colspan="2">EPIC Funds Spent:
$1,145,533</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
The Avogadro Group, LLC: $7,250 (0.4 %)
Altex Technologies Corporation: $154,478 (9.3 %)</td><td colspan="2">Match Funding:
$161,728</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The Altex developed process and apparatus for densification of biomass material will be used in the proposed FORPOWER system, to densify the Forest Slash Feedstock, for use in the system process.</td></tr>
<tr><td colspan="4">Update:
FORPOWER densification and bioenergy modules buildup and testing are ahead of schedule. The buildup of these pilot-scale test modules was originally planned for February 2019. To date, the densification module buildup has been completed and log production has been successfully tested for pine, fir and cedar forest residues. The bioenergy module buildup has also been completed and checkout testing of components is continuing during this period. Forest slash from UC Berkeley Blodgett Station were collected and processed ready for testing in the bioenergy module. A recent staff availability situation hindered their ability to fire the unit on biomass. However, the project is still planning to initiate bioenergy module biomass testing ahead of the planned start date of March 2019.</td></tr>
</table>

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Project Name: Advanced Plug Load Controls and Management in the Educational Environment [EPC-17-014]	
Recipient/Contractor: Newcomb Anderson McCormick, Inc.	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 11/8/2017 to 3/31/2021
Program Area and Strategic Objective: Technology Demonstration and Deployment S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.	
Issue: Advanced Plug Load Management Device (APMD) demonstration projects have only been conducted on a small scale (This project deploys APMD technology over a large sample size, at approximately 55,000 computer workstations at several Community Colleges, and focuses on integrating the technology with facility operations to ensure that they meet the needs of the sites and staff. Key features of the proposed project include outreach and individual education programs to California Community College Districts, evaluation of sites for participation in the project, purchase and installation of APMDs at approved sites, measurement and verification (M&V) activities both pre- and post-APMD implementation at the selected demonstration sites, and stakeholder satisfaction information from demonstration facilities staff and APMD end-users through interviews and surveys.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: Significant electricity consumption and cost savings will be delivered to the participating Community College Districts via the implementation of the APMD technology. These savings will begin to accrue as the devices are deployed in a phased approach, and be fully achieved once the EPIC project is complete. Following project completion, the APMD systems will continue to provide savings throughout their 8 to 10 year expected useful life. Successful deployment at participating Districts will then be leveraged to expand technology adoption throughout the remainder of the California Community College system.	
CPUC Proceedings addressing issues related to this EPIC project: Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]	

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Applicable Metrics: CPUC Metrics- 1f, 1h, 2a

Lower Costs:

A conservative estimate of savings to the participating California Community College Districts is $850,000 per year in immediate and ongoing annual savings.

Environmental Benefits:

Energy savings will reduce overall GHG emissions of 3,320 metric tons per year and relieve pressure on the electric grid.

Consumer Appeal:

The project gathers a wide range of data about the technology and its performance that will be incorporated into an outreach campaign to build awareness and accelerate adoption of APMD technology with IOUs, technology vendors, and property owners in institutional and commercial buildings statewide. In addition, APMDs will provide a new data visualization capability and plug load energy information system to the participating sites.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $181,567	
EPIC Funds Encumbered: $5,000,000		**EPIC Funds Spent:** $423,978	
Match Partner and Funding Split: Ibis Networks: $1,823,736 (24.6 %) Embertec: $599,034 (8.1 %)		**Match Funding:** $2,422,770	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 2: 13 out of 15 bidders	**Rank of Selected Applicant/ Bidder:** Phase 2: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The two equipment vendors, Embertec and Ibis Networks, have completed training of California Conservation Corps staff on correct installation of their devices. In 2018 the project team installed advanced plug load devices at 8 community colleges and the remaining devices will be installed at the other participating colleges in 2019.

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Project Name: Installation and Soft Cost Reduction for Horizontal Single Axis Trackers (Stage II) [EPC-17-015]	
Recipient/Contractor: Nevados Engineering	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 8/21/2017 to 12/31/2019
Program Area and Strategic Objective: Technology Demonstration and Deployment S17: Provide Federal Cost Share for Technology Demonstration and Deployment Awards.	
Issue: The solar industry has historically focused on flat land for project installations. However, flat land is not readily available everywhere, and is often expensive and dedicated to other uses like housing, roads, farming, etc. Flat land is not necessary for solar installations, but solar mounting systems have historically been designed for flat land applications. This limits potential install sites, requires substantial earth work to prepare a site for solar power plant installation, and creates substantial environmental destruction during the process.	
Project Description: This project is demonstrating a novel single axis solar PV tracking system. The innovative tracking system which can fit on sloped and rolling terrain will help solar developers build projects on lands closer to load centers and interconnection points that typically would not be considered, creating more site options. The construction costs are dramatically reduced by eliminating the need for grading soil with reduced environmental damage and mitigation costs. The new tracker was developed through a DOE award and a full-scale system is under testing at a rolling terrain near Davis. The Energy Commission grant is funding improvements and testing of the various tracker components in an effort to find cost-cutting opportunities to update the product design and optimize it for full-scale manufacturing.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The Nevados All Terrain Tracker is a single axis tracker with a unique mechanical structure, similar to the driveshaft in a pickup truck, which provides a mounting surface for solar modules that is elevated about four feet off the ground, and which rotates slowly throughout the day to follow the sun. The technology meets market requirements by providing a proven and high-quality product that meets UL-3703 safety requirements, achieving a pricing level that is competitive for the industry, and opening up 3-10X the amount of land that was previously unavailable. Solar project developers benefit directly by being able to complete	

more projects in less time for less money. Consumers benefit from having access to lower-cost clean energy and by replacing polluting energy generation technologies with clean-energy alternatives.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] California Solar Initiative: R.12-11-005

Applicable Metrics: CPUC Metrics- 1e, 2a, 3a, 3b, 4a

Lower Costs:

Installing the new solar tracking system on sloped, rough, and rolling terrain, will eliminate the need for soil grading typically necessary for solar installations, resulting in 3-10% total project cost reductions. This also increases application zones for the system to areas where only low-efficiency fixed tilt systems could be installed before, and can increase output by up to 7% over other tracking systems if installed on a south-facing slope.

Economic Development:

Through further development, testing and certifying of equipment, pilot manufacturing and business case analysis that will lead to anticipated manufacturing cost to $0.128/W or less, the technology will be competitive in the industry allowing commercialization and subsequent economic development.

Environmental Benefits:

The new tracker removes the need to grade top-soil, hence preserving the natural beauty of the site and protecting locally sensitive environments. As soil grading is diminished, millions of gallons of water usage currently sprayed on dry disturbed soil to keep dust down at construction sites will be eliminated.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $76,846
EPIC Funds Encumbered: $999,822	**EPIC Funds Spent:** $310,882
Match Partner and Funding Split: N/A	**Match Funding:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Leverage Contributors: United States Department of Energy: $1,999,542 Nevados Engineering, Inc.: $920,126 Steve Ihnen: $62,496 Nick Foster: $17,200		**Leveraged Funds:** $2,999,364	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 43 bidders	**Rank of Selected Applicant/ Bidder:** N/A
If not the highest scoring applicant/bidder, explain why selected: The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: Multiple pitches to project developers, as well as financial validation of the supply chain, have identified numerous opportunities to install solar power projects where they were previously considered impossible to install. Nevados team built a strong supply chain to achieve the pricing and quality necessary to sell to the market and has entered the commercial market in 2018 with a UL-listed product that had been tested extensively. Two projects have been installed during the award period. These advancements were made possible through funding from the Department of Energy and the California Energy Commission.			

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

An Online Siting Tool Application for Woody Biomass-to-Electricity Facilities in California

[EPC-17-016]

Recipient/Contractor:

University of California, Davis

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	11/8/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

It has been estimated that $650,000 of up-front capital is necessary in the current investment landscape to develop a biomass-to-electricity project to the point at which private capital will invest. Much of those costs are related to evaluating feedstock supply, harvest methods, transportation costs, and grid capability. Many businesses and communities that aspire to produce energy from woody biomass are small businesses, start-ups, or communities that cannot easily afford the preliminary studies necessary to assess project feasibility and how to begin development.

Project Description:

This project develops a decision support system that will reduce the soft costs of estimating and planning new bioenergy power plants that consume woody biomass from sustainable forest management activities. The open-source facility-siting tool will be hosted online and will allow users to quickly evaluate economic feasibility and environmental performance potential of particular locations for developing a wood-based biomass power plant. The project includes case study analysis to understand feasibility and barriers to developing biopower facilities in high-risk hazard zones.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will increase the cost competitiveness of biopower plant projects, resulting in expanded opportunities for using biomass waste streams. The online and open application architecture will ensure that everyone has open, public and equal access to this resource.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 3b, 3h, 4a, 5d, 5e

Lower Costs:

This bioenergy facility siting tool will achieve lower costs for renewable biomass electricity generation by reducing the cost of siting a bioenergy facility, thus increasing the cost competitiveness of bioenergy facility projects. Approximately $650,000 in up-front capital is necessary to develop a project to the point at which private capital will invest. Much of those costs are related to evaluating feedstock supply, grid capability, etc., which can be supported by the proposed application. Assuming 40% of the project initial development cost can be reduced by the siting tool, the application could save about $260,000 per project.

Increase Safety:

The bioenergy facility siting tool will reduce risk of wildfire impacts to grid infrastructure by facilitating markets for residual woody biomass, thus reducing a potential wildfire fuel source.

Environmental Benefits:

This tool will expand opportunities to use biomass waste streams that would otherwise contribute to criteria air pollutants and higher levels of climate pollutants from prescribed burns or wildfire. For a 3 MW facility, local and regional emissions reductions for NOx, PM10, VOC, CO, and CO2eq are estimated to be 80.4, 193.7, 149.6, 1,879, and 9,582 tons per year, respectively (Springsteen et al., 2011).

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $203,977
EPIC Funds Encumbered: $1,222,284	**EPIC Funds Spent:** $74,471
Match Partner and Funding Split: Regents of the University of California (University of California, Davis): $28,523 (2.3 %)	**Match Funding:** $28,523
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The forestry bioenergy siting tool project is on schedule. The spatial analysis of tree mortality task is on track to be completed by December 2018. Invitations to participate in the TAC were sent out to prospective members. The first TAC meeting will be held on January 8, 2019, tentatively at the California Energy Commission.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

The Nexus of Clean Energy, Healthy Forests, and a Stable Climate: Innovative Biomass Gasification for Sustainable Forest Management

[EPC-17-017]

Recipient/Contractor:

All Power Labs, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	10/27/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Climate change contributes to California's forest health crisis, with a tree mortality emergency of over one hundred million dead trees, at risk of being ignited in catastrophic wildfires. There is a need for an economical and climate-sensitive way to reduce the risk of catastrophic wildfire, while also addressing the state's need for renewable energy. All Power Lab's pre-commercial Powertainer, a containerized 150kW gasification system that converts forestry waste into renewable energy and sequestered carbon, technology is designed to run profitably under the SB1122 BioMAT feed-in-tariff. Yet high technological and economic barriers to widespread commercial deployment remain.

Project Description:

This project supports the development of the Powertainer+, (PT+) a multi-modal power and products platform designed to generate low-cost renewable energy, process thousands of tons of forestry waste derived from California's unprecedented tree die-off, and sequester large amounts of carbon. The Powertainer+ will include a combined heat and power module, increase the power capacity (from 150kW to between 210-250kW) and increase the forestry waste processing capacity to up to 2200 (twenty-two hundred) bone dry tons per year.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Broadly, the goals of this project are to decrease the modular technology platform's Levelized Cost of Electricity, increase its forestry residue processing capacity, add new value streams in the forms of hot water and biochar production, and enhance the system's carbon sequestration capacity.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005 Combined heat and power: D.10-12-035., R.08-06-024. [Closed]

Applicable Metrics: CPUC Metrics- 1a, 1f, 3g, 4a, 4e

Greater Reliability:

The PT+ will increase PG&E's grid reliability by reducing peak loading by up to 250kW. The technology supports increased grid reliability in hard to serve places and reduced peak demand charges for rural businesses under net energy metering arrangements. The technology will provide on-demand, non-weather dependent, renewable energy.

Increase Safety:

By creating a market demand for forestry biomass residue, this project will increase safety by creating an economic driver to support sustainable forestry management activities, thus reducing the risk of catastrophic wildfire and the associated damage to the Investor Owned Utility infrastructure, such as transmission lines and remote substations. The proposed size is now receiving over 80% of their materials from CalFire designated High Fire Hazard Zones.

Economic Development:

The PT+'s biochar offtake provides the critical linkage between the forest and agricultural industries' value chains. The PT+ creates economic benefit by selling the biochar it generates to distribution companies or directly to farmers, creating a biochar market out of the nascent demand in California. The biochar sold into this market creates economic and environmental value for the agricultural industry, as it increases soil fertility and water retention and decreases nutrient inputs and runoff.

Environmental Benefits:

By processing forestry residue from CalFire designated High Hazard Zones, the PT+ creates demand for biomass that was previously considered waste, creating value and increasing incentives to remove residues that would otherwise not be economical and providing an alternative to controlled open slash burning. This reduces GHG emissions and lowers wildfire risk.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$0
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$1,500,000	$475,744

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:
Humboldt State University Foundation, Schatz Energy Research Center: $17,235 (0.8 %)
Anderson Biomass Complex: $50,000 (2.2 %)
All Power Labs, Inc.: $682,765 (30.3 %)</td><td colspan="2">Match Funding:
$750,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project team designed and prototyped a small pre-combustion biochar offtake test bench and gasifier test bench to better profile the production and quality of biochar produced and started to prepare components for the engineering validation testing (EVT). The gasifier architecture enables pre-combustion biochar takeoff and allows experimentation with different orientations in the cracking annulus. Components of the CHP module, such as the in house producer gas and exhaust heat exchangers, are being designed, prototyped and tested before the EVT. Due to the exhaust heat exchanger design, the flare is considered a separate emission unit because it needs to operate constantly. Thus, the project team needs to prepare an amended air quality permit for the increased usage of flare. The CHP architecture is the primary pathway in which the system efficiency will be improved.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstrating the Potential for On-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units

[EPC-17-018]

Recipient/Contractor:

University of California, Davis

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	11/6/2017 to 10/17/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

The common model for managing food waste generally involves disposal in a landfill where the organic material releases methane gas (a greenhouse gas with 25 times the global warming potential of carbon dioxide) to the atmosphere as it degrades. The conversion of food waste to electricity and heat via anaerobic digestion (AD) provides a promising alternative solution to the current model, but large-scale centralized facilities require expensive and carbon-emitting transportation of food waste over long distances from its source, and small scale decentralized AD systems have not been well-demonstrated in California.

Project Description:

This project assesses the potential for a highly standardized and rapidly deployable decentralized AD solution as a compelling alternative to large-scale centralized AD facilities. By implementing on-site AD at locations where food waste is generated and electricity demand exists, it is possible to reduce/avoid 1) the consumption of non-renewable electricity, 2) the transmission and distribution (T&D) losses associated with the delivery of electricity across long distances on the regional grid, and 3) the transport costs (inclusive of the monetary, environmental, and public health costs) of hauling food waste long distances to feed larger AD generators.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project addresses the knowledge gap regarding the optimal scale for the deployment and use of AD technology to convert food waste into renewable electricity, heat, and fertilizer. To meet this need, researchers will perform techno-economic and environment assessments of increased deployment of micro-scale AD systems across the state. Researchers will also

develop new information about the performance variability of micro-scale AD systems relative to fluctuating and heterogeneous food waste feedstock inputs.

CPUC Proceedings addressing issues related to this EPIC project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1b, 2a, 3b, 3g, 4a, 4e

Lower Costs:

This project will result in the ratepayer benefits of lower costs through the on-site generation and use of electricity produced through the AD of food waste. The small-scale, on-site AD system will directly avoid the long term costs of electricity supply expansion. The pilot unit is expected to reduce the cold storage facility's net peak demand on the SCE grid by 53 kW, approximately saving $64,752 a year, or $152/MWh. By disposing the food waste onsite and locally (within 7 miles) instead of transporting it to landfills, food waste producers can avoid a total tipping fee of $72,236. At an estimate of 1% market penetration, the decentralized AD technology would save ratepayers $4.78M/year.

Greater Reliability:

This project will result in the ratepayer benefits of greater reliability through the on-site generation and utilization of electricity produced through the AD of food waste. Onsite sustainable and flexible energy generation will be able to reduce the facility’s peak load and potentially minimize the impact of unexpected power outages.

Environmental Benefits:

This technology demonstration project will reduce the amount of food waste going to landfills by about 1,220 tons of municipal food waste per year locally. The technology will avoid an estimated 427.2 metric tons of CO2 emissions per year. By implementing on-site AD at locations where food waste is generated and electricity demand exists, it is possible to reduce/avoid 1) the consumption of non-renewable electricity, 2) the transmission and distribution (T&D) losses associated with the delivery of electricity across long distances on the regional grid, 3) the environmental and public health costs of hauling food waste long distances to feed larger AD generators.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$171,649
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$2,411,007	$29,549

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:
SeaHold, LLC: $20,800 (0.7 %)
Biodico, Inc.: $610,886 (19.3 %)
UC Davis: $124,447 (3.9 %)</td><td colspan="2">Match Funding:
$756,133</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Because the US Navy withdrew from the project, UC Davis (UCD) has moved the project site from Naval Base Ventura County to Lineage Logistics, a cold storage facility in Oxnard, CA. Also, the original vendor, SEaB Energy, has been placed under administration (the UK version of bankruptcy), so UCD selected a new vendor of similar anaerobic digestion technology with comparable specifications: Impact Bioenergy, based in WA. The CEC is will consider approval of the amendment at the January 2019 business meeting. UCD has been conducting laboratory research to evaluate how daily changes in food waste characteristics affect biogas generation and quality for a continuous AD system. A waste characterization survey is being prepared to send to various food waste providers in Ventura County. The research team has also conducted a site visit to one of Impact Bioenergy's installations in Seattle.</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Burney-Hat Creek Bioenergy [EPC-17-019]	
Recipient/Contractor: Fall River Resource Conservation District	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 10/18/2017 to 9/30/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.	
Issue: As of the end of 2016, six of the 10 closest biomass power plants serving northeastern California are closed. The loss of 50 megawatts (MW) of biomass power plants has been devastating to the health of the surrounding forest lands. With this decreasing number of biomass power plants, there is a growing need to advance cost-effective, efficient and low emissions biopower facilities that are suited to local communities and further emphasizes the need to advance modular biopower technologies that could be economically transported or replicated at forest locations or be economically and easily scaled up.	
Project Description: This project seeks to bring West Biofuels gasification technology, a technology funded by EPIC under an applied research and development program grant (EPC-14-024), to full commercialization. The West Biofuels gasification solution is designed to utilize forest derived biomass and is ready for scale up demonstration and deployment. To advance its commercial readiness, this project is developing and demonstrating a community-scale forest biomass facility in the Burney–Hat Creek region that is designed to address the need for increased markets for forest biomass resources. The bioenergy facility will be consistent with the requirements of the BioMAT Category 3 and obtain a power purchase agreement at a financially viable price. The plant will consume about 22,000 BDT of forest sourced feedstock per year, generate 2.88 MW of renewable energy at full rated capacity, and have a capacity factor that is greater than or equal to 75 percent.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The Burney-Hat Creek Bioenergy facility will be the first commercial deployment of an innovative gasification system that integrates a horizontally positioned rotary gasifier based off a torrefaction reactor, a thermal oxidizer and an Organic Rankine Cycle (ORC) technology	

in place of internal combustion engine. The technology is expected to overcome important challenges with the use of forest-sourced wood, including environmental compliance and operating challenges that are hindering large scale bioenergy projects. Under a previous R&D project, West Biofuels took a measured and strategic approach to designing modular gasification system for forest materials, which brings the selected gasification technology from research to commercial operation.

CPUC Proceedings addressing issues related to this EPIC project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1b, 2a, 3g, 3h, 4a, 4b, 4e

Lower Costs:

California IOU's have been mandated to procure 250MW of biomass electricity through SB 1122. Burney-Hat Creek Bioenergy is a cost-effective option for the utilities to acquire this capacity through SB 1122 BioMAT program. Relatively low capital cost using essentially free feedstock while leveraging a local partnership of technology manufacturer and the construction company, yield a LCOE for the project that is well below the average price identified by Black & Veatch for Category 3 projects which is solid waste for BioMAT categorized as Sustainable Forest Management Byproducts.

Greater Reliability:

Distributed forest biomass projects provide important grid reliability in northeastern California, a remote region of the PG&E grid. Burney-Hat Creek Bioenergy will help provide greater reliability through: reduced power losses and the reduction in system harmonics through local distributed generation minimizing the heat generation from long-distance transmission; improved grid resilience to climate change by supporting sustainable forest management and reducing black carbon emissions from wildfire; and faster outage restoration time by providing the opportunity for micro-grid operations limiting the impact of a fault-event.

Increase Safety:

By developing the region's biomass infrastructure, the project will promote fire-safe forest management which will reduce local wildfire which protects ratepayer property and grid infrastructure.

Public Health:

Diverting biomass from pile and burn reduces criteria pollutants, which cause significant acute and chronic respiratory illness, by more than 75 percent.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$5,000,000</td><td colspan="2">EPIC Funds Spent:
$35,558</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Hat Creek Bioenergy, LLC: $5,000,000 (50.0 %)</td><td colspan="2">Match Funding:
$5,000,000</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project team continued to advance a variety of project elements. All interconnection study information has been supplied to PG&E and the team is awaiting the study results. There has been substantial progress on the engineering procurement package by the equipment suppliers and the engineering team and the final deliverables are expected by the first quarter of 2019. The project team has developed a website as part of its outreach where project information articles are posted. The project team is working with local U.S. Forest Service staff to develop new fuels treatment projects that could supply feedstock to the facility.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Demonstration of Vehicle-Grid Integration under Non-residential Scenarios

[EPC-17-020]

Recipient/Contractor:

Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	10/10/2017 to 12/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.

Issue:

There are knowledge gaps that inhibit the expansion of electric vehicles (EV) fleet charging including: 1) how to quantify the flexibility of EVs as a resource (in a consistent well-developed and tested methodology); 2) how to develop accurate physical models of charging stations and integrate these with distribution system models; 3) how to quantify and minimize the impact of EV charging on the distribution system assets; and 4) Identifying the value streams for electric vehicle fleets.

Project Description:

This agreement will demonstrate vehicle-grid integration in non-residential facilities to show the flexibility of smart charging. The team will build and validate models that incorporate usage patterns, quantify the impacts of EV charging, develop controls to manage the smart charging to minimize grid impacts and utility costs, and calculate the value streams and costs associated with realizing those value streams.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will develop and demonstrate advanced model-predictive control strategies that are more sophisticated than current state of the art technology by incorporating usage patterns, quantifying the impacts of EV charging while managing the smart charging and calculating the value streams/costs. This project will demonstrate how to minimize electric vehicle charging impacts on the distribution system while analyzing EV fleet capabilities under non-residential scenarios.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project: Alternative Fueled Vehicles: R.13-11-007 Distribution Resources Plans (AB 327): R.14-08-013	
Applicable Metrics: CPUC Metrics- 1h, 3f, 4b Lower Costs: Lower grid asset costs by extending the life of distribution grid assets and reducing peak load impacts from uncontrolled charging. In particular, the system could reduce transformer aging in hot climate regions due to reduced loading. Greater Reliability: Greater reliability due to mitigation of voltage, current and harmonics issues with EV clusters. This project is estimated to improve power losses and voltage drop by at least 10% via smart charging. Environmental Benefits: This demonstration project will accelerate EV adoption, thus reducing greenhouse gases with the adoption of more EVs.	
Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $2,340,000	**EPIC Funds Spent:** $972,883
Match Partner and Funding Split: Google Inc.: $200,000 (6.8 %) ChargePoint, Inc.: $61,248 (2.1 %) Kisensum: $75,000 (2.6 %) UC Santa Barbara: $61,345 (2.1 %) Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory): $200,000 (6.8 %)	**Match Funding:** $597,593
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	29 out of 31 bidders	Group 4: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The SLAC team collected historical data from the transformers on the distribution system at two locations on the Stanford and Google campuses to establish a baseline. The team also began collecting data from newly installed data hubs in the electric buses at Stanford, giving the team the capability of monitoring current, voltage, state of charge, and other essential parameters in real time. This data acquisition is necessary to build an accurate grid model to determine the effects of charging of vehicles. Additionally, the team developed algorithms to optimize charging under PG&E structures with time of use rates, demand charges, demand response event days, and demand response bidding.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Mariposa Biomass Project [EPC-17-021]	
Recipient/Contractor: Mariposa County Resource Conservation District (MCRCD)	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 3/21/2018 to 12/31/2021
Program Area and Strategic Objective: Technology Demonstration and Deployment S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.	
Issue: About 65% of the homes in Mariposa County are at the 2000 – 6000 ft. elevation range in the conifer or mixed conifer zone and are at risk of wildfires and falling trees. There is a need for removal of excess vegetation and a need to demonstrate advanced technologies that can economically convert woody biomass while meeting emission standards. However, no commercially proven technology has the flexibility in both the feedstock and fuel outputs. Larger scale biomass plants have difficulty scaling to below the 3MW size while small-scale pyrolysis-based systems that use a reciprocating engine have high maintenance costs and low reliability and availability.	
Project Description: This project is designing and constructing a thermochemical biomass-to-energy conversion facility for forest wood waste that will have a capacity between 2.0-2.4 Megawatt (MW) annually and produce between 15,000 to 18,500 MWh annually of renewable, community-scale, grid-connected electricity. The project demonstrates and optimizes this forest waste bioenergy technology and assesses the performance characteristics and best practices when using wood waste from forest management as feedstock. The project is located in Mariposa, CA, often referred to as ground zero for the tree mortality disaster, and will use forest biomass obtained from a high fire hazard zone.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The Mariposa Biomass Project has partnered with Cortus Energy to demonstrate an innovate gasification system trademarked as WoodRoll technology. The technology uses a 3-stage drying, pyrolysis and gasification process to produce a clean high BTU syngas, thus reducing costly engine maintenance costs and outages; and the gasification facility will integrate automation and remote monitoring to further reduce operating costs. The WoodRoll facility	

<table>
<tr><td colspan="4">will have 16 standardized factory-tested modules that can be installed quickly and moved if necessary. The combination of high efficiency and availability combined with low operating and maintenance costs will allow the Mariposa Biomass Project to be a financially successful small-scale forest biomass demonstration facility that can be replicated in other rural areas with access to sustainable forest biomass supplies.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] SB 1122 Bioenergy feed-in tariff: R.11-05-005</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1a, 1b, 3g
Environmental Benefits:
The proposed facility will provide community and state benefits, including forest ecosystem protection (due to removal of excess forest growth that can lead to catastrophic wildfires), watershed protection, and air quality benefits and greenhouse gas benefits (by diverting biomass from burn piles and controlled burns and utilizing the biomass as an energy resource in a controlled environment).</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$8,842</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$5,000,000</td><td colspan="2">EPIC Funds Spent:
$4,567</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Cortus Energy (69.0%)</td><td colspan="2">Match Funding:
$11,135,367</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project was approved at the March 2018 Business Meeting. However, the project kickoff was delayed until August 14, 2018 due to an unforeseen challenge to the county-approved Conditional Use Permit. The Mariposa project team is executing its subcontract with the primary technology provider and project developer Cortus Energy. Key initial tasks related to permits, grid connection, executing subcontracts and cooperation with partners, and site locations are ongoing and currently on-schedule. Development of a “sister plant” by Cortus Energy in Sweden is also in progress; this plant is needed to validate the design and operation and, once completed, most of its component will be shipped to Mariposa.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Skid Mounted Mobile Pilot/Education Unit for Source Separated Organics Processing with Cogeneration Capabilities

[EPC-17-022]

Recipient/Contractor:

Lystek International Limited

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	11/28/2017 to 11/29/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

California is striving to achieve a greater diversion of wastes and increase renewable energy generation. The goal of this diversion is to reduce greenhouse gas emissions from controllable sources. As an alternative to traditional solid waste facilities, other existing processing facilities, such as wastewater treatment plants, are being looked at as potential receiving stations for processed organics. The primary output of taking processed organics is greater generation or co-generation of renewable energy. A lack of proven and viable alternatives will delay meeting waste diversion goals and limit possible contributions to renewable energy goals from waste treatment facilities.

Project Description:

The project's goal is to construct and demonstrate an innovative technology to pretreat organic wastes prior to anaerobic digestion at a wastewater treatment facility to enhance operational efficiencies and increase biogas production. The pretreatment technology will be constructed as skid-mounted mobile units for processing source-separated organic wastes and biosolids and will have cogeneration capabilities, thereby further increasing the energy generation from the wastewater treatment system.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will combine the organic processes and anaerobic digestion that will yield greater biogas generation and utilization resulting in higher diversion of organic wastes while producing more renewable electricity than conventional digester systems. If successful, the combined technologies will provide wastewater treatment operators with greater confidence in working with organic generators and processors for accepting feedstock material suitable for co-digestion.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

Applicable Metrics: CPUC Metrics- 1a, 2a, 4a, 4e, 5b

Lower Costs:

The project will result in lower costs by demonstrating a technology that both diverts organic waste and increases the biogas yield and renewable electricity generation. The increase in gas production can be about 385 kW per ton of organics processed. This is an increase of at least 20% in biogas production for moderate performing anaerobic digesters. The lower quantity of biosolids resulting from the process will lower expenses for disposal management.

Environmental Benefits:

The proposed approach to biosolids processing, land application and enhanced energy recovery through the improved anaerobic digestion process may result in net greenhouse gas reductions of 47–65 tonnes of CO2 per 100 dry tonnes of biosolids processed. Assuming 723,000 dry tonnes of biosolids could be converted by Lystek in California for beneficial use every year for biogas enhancement and electricity generation, there is potential for about 339,800 Mg CO2e of GHG offset potential.

Assignment to Value Chain: Generation		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $1,589,163		**EPIC Funds Spent:** $0	
Match Partner and Funding Split: GHD, Inc.: $123,000 (5.9 %) Design2Operate: $58,000 (2.8 %) Lystek International Limited: $312,075 (15.0 %)		**Match Funding:** $493,075	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 3

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions. The Lystek Thermal Hydrolysis Process will be used as part of the organics-to energy grant project. This patented technology will be used to support the conclusion that energy can be obtained by the digestion of organic matter and the collection/conversion of biogas to electricity.
Update: The development of project's primary skid, which includes the test digesters, small flare and Lystek Processing reactor, is progressing; it is scheduled for completion in 2018 and delivered to the test site in January. Equipment commissioning will start in March 2019 and will be tested for about 6 to 8 months. All permitting requirements from Goleta Sanitary District and from the Santa Barbara Air Pollution Control District to facilitate equipment installation are in process with no major challenges being anticipated.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

High Performance, Ultra-Tall, Low Cost Concrete Wind Turbine Towers Additively Manufactured On-Site

[EPC-17-023]

Recipient/Contractor:

Jason Cotrell, dba RCAM Technologies

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	12/26/2017 to 6/30/2021

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

Large wind turbines benefit from economies of scale from larger components such as taller towers, but are constrained by the logistics and transportation size and weight. As a result, the average conventional wind turbine tower height installed in the U.S. is slightly over 80 meters tall even though an ultra-tall 140-meter tower increases the amount of energy produced by more than 21% at a site with moderate wind shear. These alternative steel and concrete tall tower configurations have not been fully explored in California due to prohibitively high manufacturing and assembly costs.

Project Description:

This project aims to develop and test a reinforced concrete additive manufacturing (RCAM) technology for building low cost ultra-tall wind turbine towers onsite at a wind plant. Taller wind turbine towers capture more wind energy from faster winds aloft, but are constrained by transportation size and weight. The key goal is to develop a RCAM technology that can be used to fabricate a hybrid wind turbine tower on-site in one day at half of the cost of conventional steel towers, and reduce the levelized cost of wind generated electricity in a low wind speed site by 11%.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Substantial recent investments and advancements in concrete additive manufacturing technologies for buildings make this an opportune time to use the RCAM technology for constructing tall wind turbine towers in California. Concrete additive manufacturing technologies are being developed by countries around the world; however, most development has been performed on concrete printing manufacturing methods for buildings that have little or no structural reinforcement necessary for highly loaded wind turbine towers.

The project team will build upon the state-of-the art technology to develop the innovative RCAM method that incorporates reinforcement in concrete printing for ultra-tall turbine towers.

CPUC Proceedings addressing issues related to this EPIC project:

Renewables Portfolio Standard: R.11-05-005 [closed], R.15-02-020 [Closed]

Applicable Metrics: CPUC Metrics- 2a

Lower Costs:

RCAM technology provides new transformative design possibilities that reduce cost and energy consumed by using less concrete and labor than conventional wind tower construction, and by eliminating concrete forms. The RCAM offers the potential of reducing the construction time by 66% and additional cost reduction potential using automation. This technology has the potential to reduce the levelized cost of wind generated electricity in a low wind speed site by 11%.

Greater Reliability:

An ultra-tall wind turbine with a hub height between 140-170 meters increases the amount of energy produced by more than 21%, compared to an 80-meter tower. For instance, 140-meter RCAM towers increase California area with gross capacity factors above 35% by tenfold, adding flexibility and reliability of the electrical system by increasing geographic diversity. Ultra-tall towers can be used with larger rotors to obtain further increases in capacity factor.

Economic Development:

If the RCAM technology is successfully commercialized, a large number of jobs in wind turbine construction, operations, and maintenance will be created in the deployment of new and repowered turbines on ultra-tall towers. These deployments will also provide lease and tax revenues in local California communities. Empirical impacts in counties hosting wind power projects that were installed between 2000 and 2008 were found to increase county-level personal income of $11,000/MW of installed capacity, and increase average county-level employment by approximately 0.5 jobs/MW.

Environmental Benefits:

Wind deployments avoid substantial emissions of greenhouse gases compared to fossil fuel generated electricity. Wind generated electricity emits up to 120 times less carbon dioxide (CO2e) than natural gas generated electricity and nearly 200 times less than coal on a lifecycle basis (5 g/kwh, 607 g/kWh, and 975 g/kWh respectively). An RCAM 140-m tower is projected to result in 85 times less CO2 compared to natural gas and 138 times less than coal fired generation on a lifecycle basis.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$164,368</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,249,982</td><td colspan="2">EPIC Funds Spent:
$61,178</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Jason Cotrell, dba RCAM Technologies: $62,558 (4.8 %)</td><td colspan="2">Match Funding:
$62,558</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
19 out of 19 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The team has conducted shear tests on material specimens to provide data for the finite element analysis (FEA) models necessary for fresh state properties, investigated mixes and reinforcement methods for 3D Casting, and added fiber reinforcement materials to the mix to evaluated the performance for printing the walls. The team also discussed methods of controlling shrinkage cracking with the Army Corps by spraying the wall of the structure with a coating after printing. The selected 3D printer design needs to be modified for concrete applications. The requested modifications to the vendor include a stronger extruder tube that can handle higher pumping pressure, different nozzle geometry, stronger and continuous pumping system, and addition of a degree of freedom to the printer head to facilitate rectangular print sections.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Electric Access System Enhancement (EASE) [EPC-17-024]	
Recipient/Contractor: Southern California Edison	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 2/1/2018 to 12/31/2020
Program Area and Strategic Objective: Technology Demonstration and Deployment S17: Provide Federal Cost Share for Technology Demonstration and Deployment Awards.	
Issue: The current trend of rapid Solar PV adoption requires a host of grid modernization efforts to manage the substantial progress SCE envisions in decarbonizing the electricity provided on the system. The existing paradigm for integration of renewables is based around legacy enterprise control solutions and a relatively static distribution planning approach. Dynamic visualization of capacity, automation of the interconnection process, and self-discovery of new devices into distributed control subsystems as part of a hierarchical control paradigm are required to achieve scalable integration of DER in excess of 50% of peak load.	
Project Description: Distributed control capabilities will enable distributed intelligence and control capability to support fast, automated decisions and improve overall resiliency of the system. This project implements a plug and play concept to facilitate service discovery from PV and batteries both under direct control and being controlled via aggregator to streamline all interconnection types and rationalize multiple systems and processes. In addition, the project explores and demonstrates distributing the existing enterprise functions, i.e. state estimation and optimization, out on the distribution system and to the edge, where necessary and desirable to securely operate the system closer to limits.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will form an architecture and cooperative framework enabling a system of systems approach that streamlines the integration of distributed energy resources from planning to operations and enabling cross optimization between different participants (IOU, third-party DER owners, CAISO) to allow exchange of services and improved utilization of assets.	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed] Smart grid: R.08-12-009 [closed] Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1d, 1g, 1h, 1i, 3f, 3h, 5b

Lower Costs:

The primary mechanism through which this project will benefit IOU ratepayers is through lower costs associated with streamlining the DER interconnection process and DER integration with utility control systems.

Greater Reliability:

This project will result in greater electricity reliability for IOU ratepayers by streamlining the DER interconnection process and the DER integration with utility control systems. The project will likely result in the ratepayer benefits of greater electricity reliability by facilitating the integration of microgrids.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $2,000,000	**EPIC Funds Spent:** $0
Match Partner and Funding Split:	**Match Funding:** $0
Leverage Contributors: United States Department of Energy: $4,188,000 Advanced Microgrid Solutions, Inc.: $495,816 (7.7 %)	**Leveraged Funds:** $4,683,816

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 43 bidders	**Rank of Selected Applicant/ Bidder:** N/A

If not the highest scoring applicant/bidder, explain why selected:

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project was approved at the January 17, 2018 business meeting, but the agreement has not been signed by SCE yet due to concerns about the EPIC terms and conditions (T&C). As of January 4, 2019, SCE has formally accepted the EPIC T&C, revised Scope of Work, and our letter of assurances. SCE is currently working on updating the budget and schedule. The CAM has a phone call with the PI scheduled for January 31, 2019 to discuss incoming changes to the DOE schedule that will affect the CEC schedule.

APPENDIX B:
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Project Name:

TradePro Connect Product and Service Procurement Project

[EPC-17-025]

Recipient/Contractor:

Cohen Ventures Inc. dba Energy Solutions

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	3/22/2018 to 4/30/2020

Program Area and Strategic Objective:

Market Facilitation

S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.

Issue:

Energy technology research, development, and demonstration lowers the risk of the customer adopter. However, this research must show that the technology addresses the needs of the adopter if the technology is to gain market traction. It is not always clear where an incumbent energy technology has potential to improve. Additionally, even entrepreneurs with well supported technologies that are targeting the right performance improvements and scientific advancements often have trouble connecting with the right investors and field test partners.

Project Description:

This project will develop and deploy an online platform, called TradePro Connect, that will allow customers to search for DER products of interest; find qualified contractors serving their area; request, evaluate and select bids; schedule services; and provide feedback on their experience via automated satisfaction surveys. Contractors enrolled in the platform will gain access to unprecedented new work opportunities, training, analytics on their services, and membership in an exclusive clean energy Group Purchasing Organization. The project aims to enroll a minimum of 100 contractor organizations on the platform, directing at least 30 percent of the jobs to small, disabled veteran, minority, LGBT and/or women business enterprises; as well as implement at least 50 projects during the 18-month project period.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

By streamlining the customer's buying experience, working with the supply-chain to stock and promote best-in-class products, and ensuring proper design, installation, commissioning, operation and maintenance, the project reduces the cost and risk of DER technology procurement which increases adoption. This leads to lower energy use and GHG emissions and also facilitates compliance with SB 350's Responsible Contractor Policy.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Integration of Distributed Energy Resources (IDER): R. 14-10-003</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1c, 3b
Lower Costs:
TradePro Connect will result in lower DER product and materials costs from suppliers due to: participation in the GPO resulting in lower mark-ups from contractors to customers; greater energy savings and lower operations and maintenance costs throughout the energy product's lifetime due to improved system commissioning; and faster recognition of savings/revenue benefits due to streamlined procurement that enables projects that would otherwise not be cost-effective to become feasible.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$0</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$991,110</td><td colspan="2">EPIC Funds Spent:
$388,705</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
ASWB Engineering: $10,000 (0.5 %)
Qmerit: $140,000 (7.1 %)
ProQure: $120,000 (6.0 %)
Ecometes: $180,000 (9.1 %)
Cohen Ventures Inc. dba Energy Solutions: $544,084 (27.4 %)</td><td colspan="2">Match Funding:
$994,084</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
15 out of 15 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Update:

After conducting a review of the products, services, and participants that would connect with the platform, the project team has soft-launched the TradePro Connect and Manage Your Power websites. The team is currently working to add the functionality necessary to integrate the websites with existing utility, contractor, and procurement programs. Once this work is complete next year, Energy Solutions and its team will turn its focus to increasing the user base and conducting training and reporting.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Accelerating the Adoption of EVs as DERs through Fleet Procurement [EPC-17-026]	
Recipient/Contractor: Lawrence Berkeley National Laboratory	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 4/16/2018 to 12/31/2021
Program Area and Strategic Objective: Market Facilitation S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.	
Issue: Corporate and government fleets across California operate hundreds of thousands of vehicles. Fleet managers face a wide range of uncertainties while considering a switch to an electric vehicle fleet. This stems from an overall lack of awareness and data on issues such as payback time from energy savings, fleet operating costs and whether EV technology, including advancements in range and smart charging, are adequate to meet fleet needs. These uncertainties create formidable barriers for fleet managers making purchasing decisions and inhibit market pull of EVs. This results in most fleet managers choosing to keep conventional vehicles, since they are the familiar choice.	
Project Description: The MyFleetBuy fleet procurement system developed in this project will mitigate uncertainties for fleet managers by providing clarity on cost savings offered by EVs and smart charging, and verifying the range of viability of EVs. MyFleetBuy will leverage the sophisticated vehicle physics models underlying the LBNL-developed MyGreenCar technology, analyzing individual fleet vehicle duty cycles and translating the analysis into easy-to-understand graphics. MyFleetBuy will provide fleet managers with a low cost, highly scalable data collection and analytics system with which to compare their options when investing in new vehicles. The platform will accelerate fleet procurement of EVs by raising awareness of options while mitigating the uncertainties that limit their adoption in fleets.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: MyFleetBuy will raise fleet managers' awareness of EVs while mitigating the risks and uncertainties that inhibit their adoption of EVs. MyFleetBuy will (1) collect high-resolution data on individual fleet vehicles, including driving distances, traffic, terrain, driving style, and more, using low-cost data loggers; (2) analyze these data with sophisticated vehicle physics	

<table>
<tr><td colspan="2">models; and (3) provide fleet managers with a decision-support tool to compare fuel costs of conventional, hybrid, or EVs; compare overall operating costs for all vehicles; and, calculate the difference in costs of uncontrolled vs. smart charging for EVs.</td></tr>
<tr><td colspan="2">CPUC Proceedings addressing issues related to this EPIC project:
Alternative Fueled Vehicles: R.13-11-007</td></tr>
<tr><td colspan="2">Applicable Metrics: CPUC Metrics- 3a, 4a, 5b
Lower Costs:
By encouraging fleet procurement of EVs with smart charging, fleet entities will minimize expensive demand charges and maximize charging during periods where time-of-use rates are lower. The operating costs for fleet entities will also be substantially lower given that typical EV fueling costs are 1/4 to 1/2 of comparable conventional cars. With increasing EV adoption, costs can be lowered for ratepayers overall, as EVs can substantially broaden the base of electric ratepayers that support recovery of the fixed costs of maintaining reliability of utility distribution systems.

Greater Reliability:
MyFleetBuy will show fleet managers how smart chargers can save them money, leading to greater penetration of smart chargers instead of uncontrolled chargers. The shift toward EVs with smart charging will help to mitigate excessive demands at fleet charging hubs, thereby avoiding local grid faults, transformer overloading, and excessive voltage deviations.</td></tr>
<tr><td>Assignment to Value Chain:
Grid Operations/Market Design</td><td>Total Budgeted Project Admin and Overhead Costs:
$115,875</td></tr>
<tr><td>EPIC Funds Encumbered:
$1,000,000</td><td>EPIC Funds Spent:
$327,282</td></tr>
<tr><td>Match Partner and Funding Split:
County of Alameda: $164,398 (5.9 %)
Caltrans: $1,342,440 (48.3 %)
City of Oakland Bureau of Infrastructure and Operations: $272,880 (9.8 %)</td><td>Match Funding:
$1,779,718</td></tr>
<tr><td>Leverage Contributors:</td><td>Leveraged Funds:
$0</td></tr>
</table>

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	15 out of 15 bidders	Group 4: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Work on this agreement began in April 2018. LBNL is currently partnered with Alameda County, the City of Oakland, and CalTrans to pilot the MyFleetBuy app. The project team has presented the MyFleetBuy app to other government fleet managers, and created a demo video which was presented at several public forums, including the ACT Expo, which is a major conference in the fleet sector. Finally, the team developed and launched a website for the app: www.MyFleetBuy.com.

In 2019, the team plans to: 1) launch the app for the initial fleet partners; 2) continue garnering feedback from fleet managers on consumer acceptance, making improvements, as necessary; and 3) continue partnering with additional fleet managers to help increase adoption of the app more broadly across the state.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

The Distributional Electricity Impacts of Climate Change on California's Residential Communities

[EPC-17-027]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/3/2018 to 4/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

California is a leader in addressing climate change and is aggressive in its policies to reduce greenhouse gases as well as local pollutants. While many have studied the national or statewide impacts of climate change, no rigorous analytics have been done to identify how different communities are affected by climate change using empirically calibrated dose response functions at the ZIP code level. Communities will not be affected uniformly; damages will vary by community as a result of climatic conditions, income levels, and population density.

Project Description:

This project studies the impacts of rising temperatures on electricity demand and the related emissions of pollutants from current generation stations. On the demand side, the researchers are creating an empirically calibrated statistical model using household level data to estimate household response of electricity demand to temperature. On the supply side, the study is estimating the implications of the increased intensity and frequency of extreme heat events from climate change on peak demand and local air pollutants, GHG emissions, and costs of generating capacity in the absence of policy intervention or technology change.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will generate new and precise estimates of the forecasted damages to California's residential communities due to climate change. This will create a scenario in the absence of additional standards and policies (e.g., additional emissions abatement requirements) and hence create a baseline for calculating their value. These two approaches will provide the most comprehensive analysis of the impact of climate change on California's residential communities and particularly on disadvantaged communities.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Strategies and Guidance for Climate Change Adaptation: R.18-04-019</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a
Lower Costs:
This Agreement will lower costs by forecasting the changes to the electricity system because of climate change so that IOUs, CAISO, and CPUC can plan a more efficient, effective, resilient, and low-cost system with less environmental impact.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$36,240</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$200,000</td><td colspan="2">EPIC Funds Spent:
$8,332</td></tr>
<tr><td colspan="2">Match Partner and Funding Split: N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
28 out of 29 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4b: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The kickoff meeting was held in June, 2018. Since then, the researchers have constructed the analysis dataset and begun running their statistical models for electricity generation and emissions under climate change.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

High Resolution Source Importance Mapping to Minimize Impacts of Waste Biomass Distributed Generation on Ozone Air Quality in Disadvantaged Communities in the San Joaquin Valley

[EPC-17-028]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/1/2018 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

The abundant waste biomass in California will be part of the renewable distributed generation goal and support solid waste diverting efforts. However, the full potential will not be reached unless the air quality impacts can be minimized. A recent study showed bioenergy production at its full potential under current permitted technologies could exacerbate ozone air pollution in the San Joaquin Valley, where many disadvantaged communities are located. To fully implement waste biomass energy generation, mitigation strategies need to be developed.

Project Description:

This project focuses on the San Joaquin Valley area and conducts a first-of-its-kind study to quantify the relative importance of individual source locations according to their ozone impacts in disadvantaged communities and non-attainment areas. The study is determining ozone polluting potential of individual project locations by application of high-resolution state-of-art chemical transport modeling coupled with other tools developed at UC Berkeley, Lawrence Berkeley National Laboratory (LBNL), and other institutions. The results are then used to develop site-specific ozone mitigation strategies.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This study maps both local and upwind emission sources that contribute to ozone air pollution in disadvantaged communities (DAC) and uses the source importance mapping to develop site-specific ozone mitigation strategies.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Distribution Resources Plans (AB 327): R.14-08-013</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 2a, 4b
Environmental Benefits:
The results from this project provide valuable new information for stakeholders regarding the greatest opportunities for efficient and cost-effective minimization of the air quality impacts from biomass distributed generation.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Generation</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$89,052</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$200,000</td><td colspan="2">EPIC Funds Spent:
$0</td></tr>
<tr><td colspan="2">Match Partner and Funding Split: N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
28 out of 29 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 4a: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project was executed in late November 2018. The project manager is working with the research team to schedule the kick-off meeting.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy [EPC-17-029]

Recipient/Contractor:

Cal Poly Corporation

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/21/2018 to 1/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

As California explores opportunities to develop offshore renewable energy capacity, there will be a growing need for pre-construction biological surveys and post-construction monitoring in the challenging marine environment. Underwater video is a powerful tool to facilitate such surveys, but the interpretation of the imagery is costly and time-consuming. Emerging technologies have greatly improved automated analysis of underwater video, but these technologies are not yet accurate or accessible enough for widespread adoption in the scientific community or industries that might benefit from these tools.

Project Description:

This agreement funds a core team of scientists, students, and staff from computer science and marine biology to perform three main development tasks that will lead to open source artificial intelligence classification capabilities: 1) performing custom convolutional neural network training focused on a number of key benthic species using an iterative training process to improve the accuracy of the prediction model; 2) developing "intelligent" video/image annotation tools to augment the capabilities of existing Video Annotation Reference System from the Monterey Bay Aquarium Research Institute to streamline annotation/classification workflows; and 3) moving the annotation software, workflow, and tools to the cloud to provide widespread adoption and reiteration/customization capabilities to the broader scientific and consulting community.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project provides advanced tools to scientists to facilitate the efficient collection of higher quality data that will provide regulators, decision makers, and the public with greater scientific certainty regarding the impact of marine renewable energy on California's marine ecological resources. Reducing the regulatory uncertainty of marine renewable energy production will

provide decision makers with better information about impacts of offshore renewables as California seeks to achieve its Renewable Portfolio Standards goals (currently 60% by 2030) and the 100% zero-carbon electricity goal established in SB 100.

CPUC Proceedings addressing issues related to this EPIC project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4f

Lower Costs:

This Agreement will lower costs by automating a costly and time-consuming task in marine biological surveys associated with planning and permitting offshore renewable energy facilities.

Environmental Benefits:

This agreement will provide the scientific community with tools that will provide regulatory agencies, decision makers, and stakeholders with higher quality data at less cost regarding status of California's marine ecosystems and the potential impact of offshore renewable energy technologies (wind, wave) on these ecosystems.

Consumer Appeal:

Reducing the scientific uncertainty of current status and potential impacts is critical to gain stakeholder/public acceptance of offshore renewable energy deployment.

Assignment to Value Chain: Generation	**Total Budgeted Project Admin and Overhead Costs:** $29,057
EPIC Funds Encumbered: $199,978	**EPIC Funds Spent:** $11,852
Match Partner and Funding Split:	**Match Funding:** $0
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	28 out of 29 bidders	Group 4b: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The kickoff meeting was held in June, 2018. The project team is nearing completion of development of the video annotation software and has begun annotating the pilot underwater video from the Monterrey Bay Aquarium Research Institute. Once these tasks are complete, they will begin developing the machine learning portion of the project. The first TAC meeting provided many useful suggestions for enhancements to the tool and for potential extensions to other applications. Computer science students are gaining real-world experience coding the software, while marine biology students are learning to identify species in the underwater video.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

California Opportunities for Procurement to Accelerate Clean Energy (Cal-OP ACE)

[EPC-17-030]

Recipient/Contractor:

Prospect Silicon Valley

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/2/2018 to 3/31/2023

Program Area and Strategic Objective:

Market Facilitation

S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.

Issue:

More distributed energy resource (DER) solutions must be deployed and adopted to meet California's energy policy goals of reducing GHG and doubling energy efficiency. Scaling DER solutions can simultaneously help buyers and sellers, but there are barriers in connecting the two parties. Large institutional customers typically purchase equipment through formal procurement processes not suited to the culture and resources of clean energy ventures. For DER technology companies to sell into institutional and commercial markets, they must navigate complicated institutional procurement processes, and procurement customers must overcome structural inertia to adopt new DER technologies.

Project Description:

This project will establish a new incubator program specifically geared towards bridging the gap between California clean energy companies and institutional/commercial customers that rely on formal procurement processes to purchase DER solutions and packages. The project will provide and coordinate key services, assistance, and resources needed to bridge the gap between emerging energy technology solutions and large-scale procurement processes. Cal-OP ACE will provide support to clean energy ventures navigating and competing in institutional energy procurement processes, while providing guidance to customers updating and streamlining their procurement processes for advanced DER technologies. Cal-OP ACE will be responsible for facilitating information sharing so clean energy ventures are aware of market opportunities provided by institutional customers; and institutional customers are aware of new DER technology features that can address their critical needs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The need for connecting DERs to Integrated Demand Side Management (IDSM) strategies has been well-established in the following state policy contexts: 1) California energy code

(Title 24) requirements for building controls and demand response (DR) capabilities; 2) AB 802 requirements for utilities to shift to Normalized Metered Energy Consumption (NMEC) to inform more rigorous utility pay for performance efficiency programs; 3) SB 350 doubling energy efficiency targets and rolling out a responsible contractor policy to ensure proper installation and commissioning of DERs; and 4) AB 793 energy management technology requirements.

CPUC Proceedings addressing issues related to this EPIC project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 1f, 2a, 3e

Lower Costs:

Cal-OP ACE will reduce costs in many ways, including but not limited to: leveraging purchasing power of institutional buyers, enabling peak demand reductions and energy and water savings from more efficient products, providing demand charge mitigation and DR opportunities from connected buildings and battery storage, and reducing maintenance costs from better equipment warranties and proper commissioning.

Consumer Appeal:

By focusing on enhanced product effectiveness, clear performance standards and certifications, strong warranties, interoperability, and robust verifiable savings, the Cal-Op initiative will help increase DER awareness and adoption in the broader consumer marketplace as well as among large institutional buyers.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$128,875
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$3,998,715	$0
Match Partner and Funding Split:	**Match Funding:**
Prospect Silicon Valley: $51,550 (1.0 %) Energy Solutions: $700,000 (13.4 %) Lawrence Berkeley National Laboratory: $150,000 (2.9 %) TerraVerde: $100,000 (1.9 %) Ecomedes: $141,000 (2.7 %) California State University - Office of the Chancellor: $101,900 (1.9 %)	$1,244,450

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
15 out of 15 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project started on August 21, 2018. Since then, Prospect Silicon Valley developed a survey for institutional buyers and DER companies to assess buyers' awareness of existing procurement programs, opportunities for improvement, and requirements for institutional procurement. Moving forward, the project work will focus on conducting surveys and developing the Cal-OP ACE website.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Port of Long Beach Microgrid - Resilience for Critical Facilities

[EPC-17-031]

Recipient/Contractor:

City of Long Beach, Harbor Department (Port of Long Beach)

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/23/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

The Port of Long Beach is planning a zero-emissions future in which electricity will be the predominant fuel and the Port-wide electrical load is expected to quadruple. This will create a significant strain on the utility grid because the difference between base load and peak load is likely to widen. Increased reliance on electricity adds risk to marine terminal operations in that a single point of failure, such as a grid outage, could result in millions of dollars per day of damage to the economy. Microgrid systems that integrate zero-emission distributed energy resources (DER) and grid services will add resiliency to Port operation.

Project Description:

This project will create a microgrid at the Port's critical response facility, the Joint Command and Control Center (JCCC). Key features include photovoltaic energy production, stationary battery energy storage, mobile battery energy storage, and a microgrid controller. Both batteries will provide grid services, such as demand response and peak shaving, during regular operation of the utility grid. During wide-spread outages or emergencies, the microgrid will support the Joint Command and Control Center, which coordinates response to emergencies. The mobile battery will act to extend the microgrid as a zero-emission generator that can be deployed where needed, such as stormwater pump stations and refrigerated container yards.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project has several innovations, including the ability to allow for direct DC transfer of energy from the PV system to the battery, significantly improving the efficiency of the stored energy, and testing charge and discharge strategies for the mobile battery to support load reduction during normal operations and providing support power to various distributed critical loads in an emergency.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project: Distribution Resources Plans (AB 327): R.14-08-013
Applicable Metrics: CPUC Metrics- 1b, 1c, 1h, 4a, 5b Lower Costs: The microgrid will reduce load during normal operations, which will lower the Ports energy costs. Smart load management reduces demand on the utility grid, specifically of peaking power, which provides important but high-cost electricity. This microgrid installation will also integrate new solar PV capacity, reducing the net demand on Southern California Edison's (SCE) system. These two factors will lower costs to electricity ratepayers by reducing expensive peak power needs and increasing the longevity of existing grid infrastructure through the production of onsite power. Greater Reliability: The proposed project will add stationary energy storage and demand response capabilities, allowing the JCCC to respond to utility signals and reduce demand during peak periods. Strategic load shaving in response to utility signals improves the reliability of utility grid services, particularly during times of peak demand. Energy Security: The microgrid will provide important ride-through capabilities during a power outage, allowing the Port's JCCC to maintain uninterrupted operations as the microgrid switches to islanded mode. Additionally, the PV system mitigates against fuel supply risk in an emergency, allowing for long-term all-renewable operations.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $5,000,000	**EPIC Funds Spent:** $0
Match Partner and Funding Split: National Renewable Energy Laboratory: $240,000 (3.4 %) Schneider Electric USA Inc.: $550,000 (7.7 %) Electric Power Research Institute, Inc.: $80,000 (1.1 %) Advanced Power and Energy Program (APEP) - University of California, Irvine:	**Match Funding:** $2,120,000

<table>
<tr><td colspan="2">$80,000 (1.1 %)
Advanced Transportation and Renewables Energy: $50,000 (0.7 %)
City of Long Beach, Harbor Department (Port of Long Beach): $1,120,000 (15.7 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
54 out of 60 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project kick-off was held in June, 2018. The project team is in the early stages of identifying energy systems integration options and opportunities for expanding the use of renewable generation, while finalizing subcontracts.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Miramar Microgrid - Flight Line Resilience through Landfill Gas and Energy Storage

[EPC-17-032]

Recipient/Contractor:

The Regents of the University of California, on behalf of the San Diego campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/23/2018 to 1/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Miramar Marine Base is a critical military facility that requires energy reliability and resiliency for mission critical operations. The Base's availability of intermittent bio gas generators can meet the electrical demand. However, the generators can sometimes be easily interrupted with the inconsistent flow of landfill bio gas. When this happens, the electrical power is switched to natural gas generators that may take considerable starting time to fully power up the Base and impact the Base's ability to reduce the use of fossil fuel. The microgrid and storage batteries envisioned by Base operations will help mitigate this issue while also increasing energy reliability and resiliency.

Project Description:

This project will install a microgrid at Marine Corps Air Station Miramar. It will incorporate five distributed energy resources: bio gas generators, solar PV, battery energy storage, and electric vehicles. When operational, the microgrid will help maintain critical flight line facilities during grid outages and facilitate higher renewable generation from landfill gas (LFG) generators.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will lead to technological advancement and breakthroughs to overcome barriers to achieving California's statutory energy goals by demonstrating a replicable and scalable solution to advance energy security and resilience through the use of a microgrid. This project will address critical challenges associated with reacting to the instantaneous loss of power from the bio gas generators by using microgrid controlled distributed energy resources such as solar PV and energy storage to mitigate any electrical interruptions while providing a reliable and resilient energy source. The technical approach and business case will be relevant to landfills with landfill gas generation, wastewater treatment plants with biogas generation, as well as hospitals, ports, and military bases.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Alternative Fueled Vehicles: R.13-11-007 Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3h, 4b, 5a

Lower Costs:

The battery energy storage system will reduce utility peak load and demand charges, which will help the Base reduce overall energy costs. This will also result in less reliance on the utility power grid during peak periods and during LFG outages, which allows the utility to defer infrastructure upgrades including distribution systems and peak generation plants.

Greater Reliability:

The microgrid will be able to shift net load to participate in time-based demand response programs, which reduces peak load and regional transmission constraints.

Public Health:

The microgrid will reduce the use of the 1.8 MW diesel generator on the Base, which will reduce emissions for the Base population. The reduction in grid congestion will help the local utility reduce reliance on peaker plants, which also reduces local air pollution.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $425,962	
EPIC Funds Encumbered: $5,000,000		**EPIC Funds Spent:** $0	
Match Partner and Funding Split: Marine Corps Air Station Miramar: $6,002,320 (54.6 %)		**Match Funding:** $6,002,320	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 54 out of 60 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 4

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: Minor delays in getting subcontractors in place but work is now proceeding to make up time.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience [EPC-17-033]	
Recipient/Contractor: The Regents of the University of California, Berkeley	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 4/20/2018 to 12/31/2021
Program Area and Strategic Objective: Applied Research and Development S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.	
Issue: ">Electricity sector operations, risk management, and planning require best available and peer-reviewed data on projected climate and weather-related parameters to maintain safe, efficient, and reliable energy. California's energy infrastructure, including power generation facilities and transmission lines, is vulnerable to climate-related risks and extreme weather events that may differ significantly from historical records due to a changing climate. Understanding projected climate-related risks that may cause disruption and energy vulnerability is critical to energy sector resilience and planning.	
Project Description: This project builds on the Cal-Adapt platform to provide enhanced tools, data services, and visualizations that leverage the existing web infrastructure and features to improve usability to energy sector stakeholders. Research team will collaborate closely with the Energy Commission and energy stakeholders including IOUs and the California Independent System Operator (CAISO) to build on Cal-Adapt, developing enhanced targeted visualizations and tools that allow for improved decision support that leverages projections of parameters associated with climate-related risk. Priority tools will address sea level rise and wildfire. These new tools are being designed in close coordination with stakeholders, as the requirements of each organization necessitates tools that are specific to their application needs. Targeted visualization tools depict climate-related risks from a variety of stressors on electricity infrastructure, enabling improved planning for future reliability.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will lead to advancements and breakthroughs that help achieve the state's statutory energy goals by providing needed actionable information on climate change	

<table>
<tr><td colspan="4">consequences on electricity generation and distribution to energy sector stakeholders. California's energy system is facing, and will continue to contend with, a changing climate. Substantial changes in the climate are projected to occur within a timeframe that overlaps with the time horizons of a variety of electricity system planning decisions, such as siting of power generation facilities and transmission lines. Regionally downscaled climate projections with high spatial resolution are valuable resources to better plan electricity and energy infrastructure developments, adaptations, and future siting.</td></tr>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Strategies and Guidance for Climate Change Adaptation: R.18-04-019</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 3a, 5c
Greater Reliability:
This project will result in benefits to California ratepayers through greater electricity reliability by supporting electricity sector planning, management, and adaptation. These benefits are derived from enhanced Cal-Adapt visualization tools that allow integration of up-to-date, peer-reviewed scientific research pertaining to climate-related risk.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Grid Operations/Market Design</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$172,916</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$900,000</td><td colspan="2">EPIC Funds Spent:
$206,392</td></tr>
<tr><td colspan="2">Match Partner and Funding Split: N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
28 out of 29 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team has established a Technical Advisory Committee that includes representatives from IOUs, a meteorologist from NOAA, CAISO, and other state agencies with whom it is important to coordinate on energy sector adaptation efforts. Newsletters have been issued (June 2018 and November 2018) to showcase recent developments, including new visualizations showing frequency of heat waves, longest stretch of consecutive extreme heat days (or warm nights) by year, extended drought scenarios, hourly sea level rise, and more. Additionally, several new datasets have been incorporated, including solar radiation and hourly sea level rise projections at key coastal sites. Early feedback from the TAC indicates that the hourly sea level rise data have already been useful in PG&E planning, specifically in siting transmission towers in the vicinity of the San Francisco Bay.

Project Name:

California Energy Product Evaluation Hub

[EPC-17-034]

Recipient/Contractor:

The Regents of the University of California, Davis-Western Cooling Efficiency Center

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/23/2018 to 3/31/2023

Program Area and Strategic Objective:

Market Facilitation

S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.

Issue:

Large customers responsible for procurement contracting are often times overwhelmed by the many choices and uncertainties surrounding advanced distributed energy resource (DER) technologies. New technologies entering the marketplace often lack rigorous, real-world evaluations that prioritize customer needs, leaving customers without pertinent details required to make better, more informed purchase decisions. This can add significant time and costs to the procurement process and deter customers from pursuing advanced DER solutions.

APPENDIX B:
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Project Description:

This project will develop the California Energy Product Evaluation (Cal-EPE) Hub to conduct and disseminate evaluations of advanced DER products relevant to large commercial and institutional customers through a web-based buyer's guide. To accomplish this, the recipient will: (1) determine Cal-EPE Hub user (i.e. large commercial and institutional customers) needs; (2) develop a list of product categories to evaluate based on user needs; (3) develop evaluation guidelines and methodologies; (4) acquire (through purchase or donation) and evaluate products from product categories; and (5) develop a web-based Buyer's Guide, which will contain the results of product evaluations and related information and documentation.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The California Energy Product Evaluation (Cal-EPE) Hub will increase the adoption of advanced DER technology products in the marketplace by disseminating reliable and independent product evaluations to large commercial and institutional customers, through a web-based buyer's guide, which will help these customers more confidently select the DER technology they require with their procurement process.

CPUC Proceedings addressing issues related to this EPIC project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed] Water-Energy Nexus: R.13-12-011 [Closed]

Applicable Metrics: CPUC Metrics- 1c, 1f, 1h, 2a, 3b, 3e, 3h, 4a

Lower Costs:

The California Energy Product Evaluation (Cal-EPE) Hub will reduce vendor noise that can add significant time and cost to procurement of DER solutions.

Consumer Appeal:

The California Energy Product Evaluation (Cal-EPE) Hub will increase consumer confidence that the DER technology solutions they are procuring are "best-in-class".

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Demand-side Management	$916,282
EPIC Funds Encumbered:	**EPIC Funds Spent:**
$10,993,646	$0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">Match Partner and Funding Split:

Lawrence Berkeley National Laboratory: $675,000 (5.1 %)
Cohen Ventures Inc. dba Energy Solutions: $420,000 (3.1 %)
Center for the Built Environment - UC Berkeley: $120,000 (0.9 %)
Local Government Commission: $25,000 (0.2 %)
Collaborative for High Performance Schools: $25,000 (0.2 %)
Sheet Metal Workers 104 & Bay Area Industry Training Fund: $99,000 (0.7 %)
Western Cooling Efficiency Center - UC Davis: $983,629 (7.4 %)</td><td colspan="2">Match Funding:

$2,347,629</td></tr>
<tr><td colspan="2">Leverage Contributors:

N/A</td><td colspan="2">Leveraged Funds:

$0</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

15 out of 15 bidders</td><td>Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:

Overall, the project is on schedule. The recipient has already completed the following in preparation of evaluating products:
- Developed the interview guide for interviewing potential Cal-EPE Hub users about their specific needs regarding advanced DER products.
- Compiled a list of target customers (large commercial and institutional customers) to interview and conduct surveys with.
- Compiled a list of eligible product categories that will be considered for evaluation.

In early 2019, the recipient will focus on the following:
- Conducting interviews, developing the survey guide, and conducting surveys with target</td></tr>
</table>

customers.
- Recording the findings of the interviews and surveys within the Hub User Needs Report to help direct product category selection.
- Performing activities to determine which product categories to evaluate, and what their priority will be in the evaluation schedule.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley [EPC-17-035]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/1/2018 to 1/31/2022

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Fresno is a disadvantaged community with high unemployment and poor air quality. The high pollution load contributes to adverse health outcomes. The disadvantaged communities in Fresno also suffer from lack of air-conditioning or cannot afford to run air conditioning during hot summer months, which significantly impacts occupant health. At the same time, access to clean technology options (e.g. solar PV, major energy efficiency upgrades, battery-electric vehicles) is constrained in disadvantaged communities by many structural barriers.

Project Description:

This project develops a holistic community action plan to achieve climate benefits and air quality improvements through energy efficiency measures, electrification, and distributed energy resources in the residential building and light-duty and medium-duty transportation sectors in the city of Fresno. Field survey and validation testing provide inputs on appropriate implementation strategies and selection of systems and technologies to overcome barriers associated with site characteristics and user responses. The researchers are monitoring energy use and air quality in typical households within the disadvantaged communities for accurate and realistic inputs in the analysis for large scale implementation of similar programs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project provides state-of-the-art information and analyses on the impacts of prioritized and integrated energy efficiency, electrification, and distributed energy resources, and battery electric vehicles, in the Fresno area on climate benefits and air quality improvements.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="4">CPUC Proceedings addressing issues related to this EPIC project:
Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]</td></tr>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1f, 2a, 4b
Public Health:
The energy action plan developed by this agreement will provide city of Fresno and other similar cities in California pathways to reduce energy costs to their residents, and to improve air quality and public health.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Distribution</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$401,103</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$1,100,000</td><td colspan="2">EPIC Funds Spent:
$454,691</td></tr>
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$0</td></tr>
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N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
28 out of 29 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2b: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project kick-off meeting was conducted in November 2018. The research team is working on obtaining energy and building data from different sources such as the utility company and the city of Fresno.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Camp Parks Army Microgrid – A Blueprint for Nested, Modular Design

[EPC-17-038]

Recipient/Contractor:

DOE- Lawrence Berkeley National Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/23/2018 to 3/30/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Military bases must ensure uninterrupted energy access, optimal use of energy resources, and building energy security and resilience to reduce vulnerability and risks. To maximize the use of bases, the military is moving toward multiple zoning with mixed military and commercial tenancy, collaborating with local communities to implement innovative, sustainable technology and business solutions. Enabling smaller microgrids nested within a larger microgrid would give the military the greatest flexibility and resilience.

Project Description:

The Parks Reserve Forces Training Area (PRFTA) microgrid project will produce a permanent, modular, nested design that maximizes renewables and is inherently secure, expandable, economically viable and efficient. The project will deliver a blueprint for incorporating multiple distributed energy resources (DER); a vendor-neutral microgrid control system; and a resilient nodal building block approach that supports grid-within-grid nesting. The project will also develop engineering guidelines and an easy-to-adapt "how-to" case tool for accelerated adoption and commercialization.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will demonstrate how a nested set of smaller microgrids within an overall base microgrid can be designed and operated to provide resilience on the base, while substantially reducing energy use and the need for multiple backup diesel generators. This approach can be transferrable to other military bases or similar commercial or academic campuses or local communities to improve resilience.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1h, 2a, 3h, 5a

Lower Costs:

The base will be able to reduce electricity procurement by ~3,100 megawatt-hours (MWh) per year. The expected savings at PRFTA is ~$600,000 per year. Additionally, ratepayer benefits from the installation of a 2 MW PV with 2 MW/4 MWh energy storage would enable the utility to defer up to 1 MW of distribution level upgrades at the local substation.

Environmental Benefits:

The project will enable the utility to reduce GHG emissions by ~1,300 tons and to reduce the use of diesel generators as backup power.

Energy Security:

It would ensure energy quality and reliability, and continuity of critical operations in islanded mode with renewable assets for the requisite 14 days.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $817,221
EPIC Funds Encumbered: $5,000,000	**EPIC Funds Spent:** $0
Match Partner and Funding Split: Customized Energy Solutions: $30,000 (0.2 %) Ultrasolar Technology: $287,900 (1.8 %) U.S. Army: $11,093,000 (67.6 %)	**Match Funding:** $11,410,900
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 54 out of 60 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 3

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The agreement was fully executed on December 7, 2018. The kick-off meeting will take place in early 2019.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

DER-VET A Distributed Energy Resource Value Estimation Tool

[EPC-17-039]

Recipient/Contractor:

Electric Power Research Institute, Inc.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

Grid planners and technology developers struggle with the ability to design and site microgrids to achieve the greatest economic opportunities. Currently there is not a good way to determine the right size of individual distributed energy resources (DER) and the benefits and challenges of their integration for a facility's needs. These factors and the microgrid location will affect the economics of the microgrid impacting financial payback.

Project Description:

This project will develop the Distributed Energy Resource Value Estimation Tool (DER-VET), a publicly-available, open-source, microgrid valuation and optimization software tool to aide in the design of microgrid and distributed energy resource deployments.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will lead to technological advancement and breakthroughs by developing a new tool for microgrid development by utilities and developers that will evaluate how the DER and microgrid systems can be optimized for sizing, owner benefits, and use as flexible grid resources.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1b, 1c, 1f, 1h, 5b, 5f

Lower Costs:

The tool will allow microgrids to be developed with optimal mix of DER to maximize financial return through cost savings and by providing grid services such as demand response or

<table>
<tr><td colspan="4">ancillary service participation.

Greater Reliability:
The tool will evaluate how microgrids will provide reliability and resiliency to the grid through better integration of renewable sources and reduced or avoided outage times.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Distribution</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$0</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$2,000,000</td><td colspan="2">EPIC Funds Spent:
$0</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
XENDEE: $170,800 (6.7 %)
Electric Power Research Institute, Inc.: $397,310 (15.5 %)</td><td colspan="2">Match Funding:
$568,110</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
28 out of 29 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
This project was launched in May 2018. The team developed the draft model specification and the software development plan and will be vetting the approach to a representative user community prior to full development.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities

[EPC-17-040]

Recipient/Contractor:

Prospect Silicon Valley

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/29/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

Technology Demonstration and Deployment

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors
S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings

Issue:

The Net Zero Energy Coalition, an organization focused on accelerating market adoption of net-zero energy buildings and communities in North America, states in its 2017 Residential Zero Energy Inventory that only 5,279 new single and multifamily units in California are currently operating at ZNE performance or zero energy ready. This represents a very small portion of the existing building stock of nearly 13 million units per the 2017 US Census. To achieve the state's zero carbon goals especially for multifamily buildings by 2030, research is needed to identify opportunities to drive down retrofit costs, energy costs and carbon emissions.

Project Description:

This project will develop and demonstrate standardized energy efficiency retrofit packages, specifically geared towards low-income multifamily housing market, and that can be scaled to drive down costs. As part of the agreement, the recipient will develop a business model for these packages to overcome financing challenges.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Significant improvements in retrofit production speed and cost reductions are critical to realizing a mass-scale existing building energy efficiency improvements. Even when pairing the significant grant funding from the State's Low-Income Weatherization Program for Multifamily Properties, it is rare that those retrofit projects alone can achieve ZNE. The key to bringing costs down and construction speeds up is to simultaneously address the technical

and business model barriers that still exist in the market. Some of the innovative approaches the project team is considering include: modularized, pre-fabricated, pre-insulated building enclosures, packaged multi-function heat pumps for heating, cooling, energy recovery ventilation, advanced heat pump water heaters, and behavior modification technologies and strategies.

CPUC Proceedings addressing issues related to this EPIC project:

Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 2a, 3a, 3b, 3f

Lower Costs:

One out of every three low-income families report facing challenges in paying their energy bills, which could include forgoing purchasing food or keeping their apartments at unsafe temperatures. This project could result in the potential for a fixed energy expenditure and allow for potential cost savings to building owners as the cost of retrofit solutions come down due to mass scaling. There is also potential for tenants to financially benefit from taking part in additional revenue streams such as demand response programs.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $1,307,443
EPIC Funds Encumbered: $7,204,308	**EPIC Funds Spent:** $0
Match Partner and Funding Split: Association for Energy Affordability: $6,499,062 (46.7 %) City of San Francisco Department of Environment: $900 (0.0 %) Stone Energy Associates: $700 (0.0 %) Rocky Mountain Institute: $204,646 (1.5 %)	**Match Funding:** $6,705,308
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 18 out of 18 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project had a kickoff meeting in October 2018. In December 2018 a stop work order was issued for team organization reasons. The project will move forward once these issues are resolved.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Lead Locally

[EPC-17-041]

Recipient/Contractor:

Sonoma Clean Power Authority

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/1/2018 to 6/30/2022

Program Area and Strategic Objective:

Applied Research and Development

Technology Demonstration and Deployment

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors
S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings

Issue:

Substantial potential for efficiency improvements remains untapped in the existing building stock, but effective strategies that generate widespread consumer interest and adoption have yet to be implemented. The specific challenges of doubling efficiency by 2030 will depend on:

- Expanding adoption of energy efficiency upgrades that go beyond existing codes and standards.
- Advancements in technologies to increase performance and reduce equipment and labor costs.
- Innovative deployment and funding strategies, business models and private/public partnerships and informed decision-making to spur mass adoption and scale-up.

Project Description:

In the applied research phase of the project, the team is evaluating promising emerging efficiency technologies to determine whether these technologies can meet cost-effectiveness, feasibility, and customer acceptance thresholds that would allow them to be included in the existing building retrofit strategies developed under this project. In the technology deployment phase, the team is taking a three-pronged approach to increase existing building retrofits. The first will be development of an "Energy Marketplace" where consumers can directly procure technologies appropriate for their buildings. The second will be to combine financing options with mid-stream rebates to greatly expand the pool of customers who can take advantage of the Energy Marketplace. This will target those who have little to no upfront capital and are the most difficult to reach. And third, training will be offered to contractors,

realtors, and building officials with the goal of greatly increasing customer knowledge, decreasing code violations, and increasing penetration of energy efficiency measures outside the framework of utility programs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project could increase market penetration for existing building retrofits and result in deeper savings per site using the existing program funding that SCP and the investor-owned utilities will allocate in future years. The project anticipates providing a full range of options for customers--from whole building integrated retrofits to partial retrofits and traditional equipment upgrades, depending on the customer's interest, budget, and need. The high level estimated net present value of the project benefits is over $60M in 2030. Additional benefits could be realized if fuel-switching strategies that are being evaluated as part of the applied research phase of the project meet cost-effectiveness, feasibility, and customer acceptance criteria and can be included in the Energy Marketplace.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs:

Lower costs could be achieved through a dual approach of directly reducing customer utility bills through installation of energy efficiency measures and decreasing implementation costs by providing training and direct customer access.

Greater Reliability:

Greater electricity reliability will be established through electricity savings, tailoring program measures to those that will best reduce peak kW usage and grid challenges in the Sonoma Clean Power service territory. Additionally, many of the strategies investigated in the applied research phase have the ability to integrate into the existing Sonoma Clean Power DR platform for additional grid reliability gains.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $4,687,705
EPIC Funds Encumbered: $9,814,596	**EPIC Funds Spent:** $11,891
Match Partner and Funding Split: TBD - Design Build Contractor: $99,000 (0.8 %)	**Match Funding:** $3,335,500

<table>
<tr><td colspan="2">Sonoma Clean Power Authority: $585,000 (4.4 %)</td><td colspan="2"></td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
18 out of 18 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project is on schedule. The Evaluation Framework and Research Plans have been completed and over 200 Sonoma Clean Power customers have applied to have their homes/small businesses included in the research phase of the project. Suitable test sites will be selected according to the research framework and installations will begin in Q1 2019. The "Energy Marketplace" storefront site has been established and renovation plans are under development. The facility is on track to open, on schedule by Q3 2019.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Camptonville Biomass-to-Energy Project

[EPC-17-042]

Recipient/Contractor:

ICF Incorporated, L.L.C.

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	11/1/2018 to 3/31/2022

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

California is experiencing unprecedented levels of tree die-off. Factors that are contributing to the die-off include several consecutive years of drought, warmer temperatures, and an infestation of bark beetles. The dead tree population in California greatly exceeds the level expected for healthy forests, and this overabundance of forest fuel increases the risk of catastrophic wildfires that threaten property and lives. Bioenergy is captured as one solution to help manage forest biomass volumes; however, there is a need to demonstrate technologies that can economically convert biomass to electricity.

Project Description:

The project will demonstrate an innovative 3 MW biomass power plant located in Camptonville, California that will: produce a replicable power plant design that can help reduce costs for future plants, accelerate adoption of comparable capacity biomass plants at other California locations, demonstrate a robust direct combustion technology that has the flexibility to utilize diverse biomass feedstock available throughout California, validate significant reductions in NOx, CO, and VOC emissions, reduce water consumption required for biomass power generation, and increase availability of renewable electricity and grid reliability while reducing emissions and wildfire threats.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The plant's key technologies have been successfully used as individual components, but they have not been demonstrated as an integrated system at the relatively small scale (3 MW) intended for this project. The innovation for this project is to design and build a 3 MW forest biomass-to-electricity power plant using an advanced emissions control and low water use condenser. The facility is estimated to consume 30,000 bone dry tons of woody biomass annually, which will be derived from dead and diseased trees and forest byproducts

harvested from public and private forested lands near Camptonville, California.
CPUC Proceedings addressing issues related to this EPIC project: SB 1122 Bioenergy feed-in tariff: R.11-05-005 Renewables Portfolio Standard Program: R.18-07-003
Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 2a Greater Reliability: Power will be exported to PG&E, which will help increase grid reliability in rural regions near Camptonville and the surrounding foothill communities. Increase Safety: By utilizing dead and diseased trees and forest byproducts, this project will reduce the risk of catastrophic wildfires, thereby mitigating threats to people and property. Economic Development: The Camptonville project will create living-wage jobs in economically distressed Sierra Nevada communities by demonstrating a successful business model for biomass utilization. The Camptonville plant is estimated to create up to 27 full time new jobs. This employment increase is expected to cut the unemployment rate in the community by more than 50% (decrease from nearly 9% to about to 4%). Environmental Benefits: The Camptonville project will generate power using advanced emissions controls that will keep NOx, CO, and VOC emissions well within air district limits. In addition, the project will use an advanced condenser for heat rejection that will significantly reduce water consumption. Consumer Appeal: This project is a community-based initiative that has many supporters, including local community organizations and agencies, environmental organizations, regional timber operators, county and State government representatives and agencies, Federal land management agencies, and several air quality management districts.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Generation	$0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$4,999,830</td><td colspan="2">EPIC Funds Spent:
$0</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Phoenix Energy: $13,030,225 (72.3 %)</td><td colspan="2">Match Funding:
$13,030,225</td></tr>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
51 out of 81 bidders</td><td>Rank of Selected Applicant/ Bidder:
Ranked # 4</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project was approved at a Business Meeting on October 3, 2018. However, the agreement is not executed and is being placed on hold due to a recent project site issue. The current project site is pulling out and thus the project is in need of finding an alternative site. Finding and readying an alternative site will tremendously impact the schedule; it may require a new CEQA study and interconnection requirements from CAISO and PG&E.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

GLOW: A User-friendly Interface for GridLAB-D

[EPC-17-043]

Recipient/Contractor:

Hitachi America LTD

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

GridLAB-D is an open-source electric system simulation tool developed by the U.S. Department of Energy. It is used by the electric power industry to support policy development and to address planning and operational needs, including simulating DER impacts on the electric system. However, it has an antiquated user interface, which requires users to memorize command lines and build scripts in languages such as Python to enter data into the model. An intuitive interface would significantly improve the use of this powerful tool for power system modeling in California.

Project Description:

This project is developing GridLAB-D Open Workspace (GLOW), an intuitive interface for GridLAB-D that will provide a user-friendly environment for researchers, planners, developers, and regulators involved in advanced electric grid technology modeling. The interface will simplify data input and simulations, enable visualization of complex information, and be scalable for big data simulations. GLOW will be a freely available and widely supported open-source tool based on existing GridLAB-D technology.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The technical advancement of the project is the development of an intuitive and widely available user interface for GridLAB-D, a software simulation tool for advanced distribution system modeling developed by the U.S. Department of Energy.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Applicable Metrics: CPUC Metrics- 3b, 3c, 5b

Lower Costs:

Lower modeling costs will be achieved by developing a new, intuitive and convenient user interface, which will reduce the high costs of training due to the current, cumbersome and challenging interface of GridLAB-D. The improved interface will lower the barrier to widespread use.

Greater Reliability:

Greater electricity reliability is achieved by improving distribution planning through modeling to determine impacts of DERs and controllable loads on distribution networks and substations. The development of a user interface will increase access to simulation and modeling results for advanced power system solutions by technology developers, researchers and public agencies.

Consumer Appeal:

Consumer appeal is achieved by developing a user interface that is intuitive and more convenient to non-expert users. This will result in GridLAB-D becoming more widely adopted due to the increased ease of use and lower level of training required to perform simulations using a simple user interface.

Assignment to Value Chain: Distribution		**Total Budgeted Project Admin and Overhead Costs:** $0	
EPIC Funds Encumbered: $2,999,699		**EPIC Funds Spent:** $689,172	
Match Partner and Funding Split: Hitachi America LTD: $1,175,060 (27.6 %) National Grid: $80,000 (1.9 %)		**Match Funding:** $1,255,060	
Leverage Contributors: **N/A**		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 28 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 4: Ranked # 1

APPENDIX B:
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If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project was kicked off in August, 2018. The team has started interviewing California users of GridLAB-D to develop use cases. This user input will guide the development of the screens and user interface for GLOW.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name: Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California [EPC-17-044]	
Recipient/Contractor: InTech Energy, Inc.	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 6/13/2018 to 3/31/2022
Program Area and Strategic Objective: Applied Research and Development Technology Demonstration and Deployment S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.	
Issue: Wide-scale energy efficiency retrofits lag behind technical and market potential. Utility programs are often difficult to participate in, and commercial customers lack the knowledge to understand how to plan for and finance a complex retrofit on their own. This leads to unrealized retrofit projects and energy waste and untapped economic benefits. Increased energy efficiency adoption depends on customer engagement and education, as well as cost effectiveness of the programs to get projects to customers.	
Project Description: This project is developing a web-based marketplace platform for connecting customers with energy service providers, technologies, and lenders; installing retrofits at a variety of commercial customer sites in southern California, including schools, community centers, and a refrigerated warehouse; and developing a scalable, programmatic model for commercial customer retrofits. The projects will also evaluate pay-for-performance concepts including financing components to offset customer costs, insurance markets to reduce perceived risk for lenders, and a sales-as-a-service marketplace where efficiency products and services are connected with sales professionals.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will accelerate the adoption of market-driven, pay-for-performance retrofits at commercial customer sites. It does so by creating a scalable, programmatic model for	

undertaking a retrofit. This project will also maximize market potential by using Sales-as-a-Service marketplace energy efficiency technology where customers, products and supporting services can connect with industry professionals. Through this marketplace, the value of energy efficiency will be standardized and transparent, lowering cost and time to implement these technologies. The combination of these methods, along with new energy efficiency technologies in the demonstration sites, will showcase how cost-effective, energy-efficient solutions can be provided in a timely fashion.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h

Lower Costs:

This project will benefit ratepayers by lowering energy costs for commercial customers. It is estimated that equipment integration and installation costs can be reduced by ~80%. The benefits include substantial energy savings from energy efficiency measures, and integration with utility demand response programs to capture the benefits of time-dependent utility pricing.

Assignment to Value Chain: Demand-side Management		**Total Budgeted Project Admin and Overhead Costs:** $2,139,730	
EPIC Funds Encumbered: $7,199,315		**EPIC Funds Spent:** $90,067	
Match Partner and Funding Split: InTech Energy, Inc.: $2,600,274 (26.5 %)		**Match Funding:** $2,600,274	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 18 out of 18 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: This project began in September 2018. The recipient is developing a mock-up for the Sales-as-a-Service platform tool.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Oak View Microgrid: Using Microgrid Technologies to Simultaneously Improve Quality of Life and Electric Grid Operations

[EPC-17-045]

Recipient/Contractor:

The Regents of the University of California, Irvine Campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/16/2018 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

Disadvantaged communities suffer disproportionally from the environmental impacts of energy conversion. Technologies that can combat poor air quality also have the potential to, when designed properly, improve grid performance and grid resiliency through the creation of a microgrid. Currently, there are no existing methodologies that consider simultaneously air quality, grid reliability, and grid resiliency for microgrid design. In addition, there is a dearth of experience designing microgrids while improving building energy efficiency and retrofitting at a reasonable cost.

Project Description:

This project develops multiple urban energy scenarios (UES) in which multiple types of energy efficiency, electrification, and microgrid technologies are considered. The design approach will use integrated methods that simultaneously consider the various technology and retrofit options, while also verifying that the proposed technology mixes accomplish the goals of improving air quality and grid operations. The work will result in the proposal of a microgrid design ready for implementation in Oak View, extensible UES that can be used throughout the State, and an extensible and robust design methodology that can be used throughout the state for economic and environmentally sensitive microgrid development.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will advance the integration of emerging and proven green energy technologies, with various end-uses in the Oak View community helping to facilitate the implementation of SB 535 and AB1550 that require maximizing benefits from low-carbon technologies to disadvantaged communities. For the first time, this study will assess ways to reduce particulate matter, nitrogen oxides and other indoor and outdoor air pollutants associated with appliances used in homes and electricity generated and served to the subject community.

The research team will use big data to develop decarbonization pathways for the energy system in a targeted community that will include increased energy efficiency improvements within existing residential buildings, renewable energy generation and energy storage technologies, vehicle electrification, and electrification of natural gas appliances.	
CPUC Proceedings addressing issues related to this EPIC project: Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007 Strategies and Guidance for Climate Change Adaptation: R.18-04-019	
Applicable Metrics: CPUC Metrics- 1f, 1h, 2a, 4a, 4b Lower Costs: The designed microgrid could decrease transmission/distribution losses and reduce the need for new transmission infrastructure. Greater Reliability: Microgrid design developed under this project could serve the critical loads inside a community without interruption, provide ancillary services to the grid during normal operations, and provide black-start capability. Public Health: The designed microgrid is expected to reduce greenhouse gas emissions and criteria emissions, leading to improved air quality and providing health benefits to communities.	
Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $157,594
EPIC Funds Encumbered: $1,099,760	**EPIC Funds Spent:** $0
Match Partner and Funding Split: National Renewable Energy Laboratory (NREL): $118,000 (8.0 %) Altura Associates, Inc.: $20,000 (1.4 %) County of Orange/City of Huntington Beach: $20,000 (1.4 %) ComUNIDAD: $50,000 (3.4 %)	**Match Funding:** $367,804
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	28 out of 29 bidders	Group 2a: Ranked # 2
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: The project was kicked off on November 26, 2018. In early 2019, the research team will collect “big data” for electrical and natural gas consumption capturing information on the current state of the built environment (building types, construction materials, design, vintage, functionality, disrepair, etc.) in the Oak View community. The data will be used to determine energy efficiency retrofit measures and suitable microgrid technologies for the community.			

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Project Name:

HiPAS GridLAB-D: A High-Performance Agent-based Simulation using GridLAB-D

[EPC-17-046]

Recipient/Contractor:

SLAC National Accelerator Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

GridLAB-D is an open-source electric system simulation tool developed by the U.S. Department of Energy. It is used by the electric power industry to support policy development and to address planning and operational needs, including simulating DER impacts on the electric system. However, GridLAB-D software does not take advantage of modern computing hardware (i.e., parallel processors). This results in extremely slow processing time for electric system simulations, increasing the time and cost of evaluating multiple scenarios, which is necessary for policy development and operational planning.

Project Description:

The HiPAS GridLAB-D project will increase the performance of the open-source version of GridLAB-D and improve the broad accessibility of high-performance power grid modeling capabilities to the community of smart grid modelers and distribution simulation users in California.

HiPAS includes methods that parallelize many of the iterative methods used in simulations. HiPAS is intended for both desktop multi-core processors and cloud platforms. It will enable GridLAB-D users to more efficiently analyze multiple scenarios with improved resolution by reducing the computational costs associated with analysis.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will achieve technology advancement and usability breakthroughs in the following performance areas: 1) Granular object-level parallelization of computations; 2) Large-scale parametric job control; 3) Sensitivity analysis; and 4) Monte Carlo analysis. These will improve the accessibility and applicability of GridLAB-D to users in California's utilities, government agencies, and researchers who are concerned with system policy, planning, operation and oversight in the presence of growing customer-based demand response and renewable energy resources.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 [Closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1a, 1b, 3a, 5b

Lower Costs:

HiPAS GridLAB-D will address the primary barriers to analyzing more grid locations for DER deployment, by reducing the computational costs associated with these kinds of analyses. This will reduce the cost for interconnection studies.

Greater Reliability:

The HiPAS enhancements to GridLAB-D achieved through this project will increase utility analyst productivity in performing DER integration studies by improving the accuracy and timeliness of results supporting DER interconnection and grid planning.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $3,068,781	**EPIC Funds Spent:** $1,248,211
Match Partner and Funding Split: National Grid: $300,000 (8.9 %)	**Match Funding:** $300,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 28 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 3: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Terms and Conditions.
Update: The project was recently begun. The team has begun working with Pacific Northwest National Laboratory, which developed GridLAB-D and is helping to refine the computational code that will allow the software to run more efficiently, and thus reduce calculation time and expense.

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Project Name:

OpenFIDO: An Open-source Framework for Integrated Data Operations

[EPC-17-047]

Recipient/Contractor:

SLAC National Accelerator Laboratory

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

Enabling the sharing of information across distribution planning tools will save time and money. Although various tools are used in distribution planning, they come from a diverse number of suppliers and do not work within a single user framework to interact and share information. Utility planners and grid researchers need a tool and integration framework to quickly move data from one application to another as part of their engineering, planning, and review activities.

Project Description:

This project will develop OpenFIDO an open source tool to transfer models and data between various programs that are part of the suite of tools used in by utilities, distributed energy resource (DER) engineers and regulators in California. The tool is an integration framework to quickly move data from one application to another as part of their engineering, planning, and review activities.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Current modelling tools do not support the exchange of data to other programs. This is not sufficient when many different tools are used to analyze the many multi-disciplinary problems energy system researchers, analysts and regulators must address. OpenFIDO proposes to use an open multi-standard approach to data exchange called polyglot representation. This approach allows data to be exchanged so that data models of commercial buildings, retail tariffs, and distribution networks can be reliably exchanged between the various distribution system analysis tools that are currently used.

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CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1b, 1c, 5a, 5b

Lower Costs:

The capabilities of OpenFIDO will help utilities more reliably and efficiently exchange system model data with analysts, regulators, and vendors. The reduction in labor intensity and staff training will improve productivity, to lower overall costs.

Greater Reliability:

Determination of the grid impacts of DERs requires multiple iterations of power flow analysis, which utilities perform as part of their interconnection studies. This requires analysis using multiple tools that must exchange data. Greater data exchange will enable deeper analysis of the impacts of DERs and the measures to limit those impacts to maintain and increase reliability.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $367,282
EPIC Funds Encumbered: $1,000,000	**EPIC Funds Spent:** $287,976
Match Partner and Funding Split: National Grid: $30,000 (2.9 %)	**Match Funding:** $30,000
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 28 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 2: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement

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Terms and Conditions.
Update: The project has just started. The project team is conducting research of end users to identify the most used planning tools in California. Preparation is underway to hold a requirements identification workshop to identify the various planning tools and the priority needs for data interchange.

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

Engaging Communities in the Design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley

[EPC-17-048]

Recipient/Contractor:

The Regents of the University of California, Berkeley

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	4/16/2018 to 6/30/2022

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

Interdisciplinary analysis of California's energy futures, in particular in the Southern San Joaquin Valley, is critical to the question of the potential for development and energy transformation in dense urban environments at the interface of California's agriculture lands, communities, and natural resources. This research specifically addresses the people and communities most affected by development in these areas. Their vulnerability derives in part from living in "urban-agriculture interface zones." This project aims to advance the engagement of communities in the design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley.

Project Description:

Through the analysis of "big data" comprising remotely sensed images (e.g. agriculture lands, road networks, built environment) and Geographic Information System (GIS) layers (e.g. energy consumption, distribution networks, new build construction, reserve areas and planning documents), the project team is developing an analysis that isolates specific dense urban areas with both high potential for retrofits and energy system synergies while meeting the needs of disadvantaged communities. Through the identification of critical "Urban-Agriculture Interface Zones" using a GIS-based hot spot analysis across the Southern San Joaquin Valley, the project identifies and engages with communities to develop Sustainable Energy and Localized Futures (SELF). Contact with SELF communities is through community-based organizations. This project identifies opportunities in the SELF communities for efficiency and energy system improvements based on analysis of energy optimization tools such as the Solar, Wind, Investment in Technology, Hydropower (SWITCH) model. An optimization model is being developed for these densely populated zones to design "SELF- SWITCH" systems (SELF-SWITCH model).

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How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This research is advancing the state of the art by developing a new model that can explore the cost and feasibility of generation, transmission, and storage options for the future electricity system in a sub-regional environment. The model identifies cost-effective investment decisions for meeting electricity demand, taking into account the existing grid as well as projections of future technological developments, renewable energy potential, fuel costs, and public policy. Integrating this model with updated GIS and geographically relevant data and algorithms for a sub-regional development will assist California's energy system planners.

CPUC Proceedings addressing issues related to this EPIC project:

Applicable Metrics: CPUC Metrics- 3a

Lower Costs:

The project will lower long-term costs through identification of transformational system upgrades that deliver energy efficiency in dense urban zones.

Greater Reliability:

The project will result in the ratepayer benefits of greater reliability by identifying environmental and system risks of meeting transformational and system upgrades in the Southern San Joaquin Valley region.

Assignment to Value Chain: Grid Operations/Market Design		**Total Budgeted Project Admin and Overhead Costs:** $164,853	
EPIC Funds Encumbered: $1,100,000		**EPIC Funds Spent:** $0	
Match Partner and Funding Split: N/A		**Match Funding:** $0	
Leverage Contributors:		**Leveraged Funds:** $0	
Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 28 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 2b: Ranked # 2

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project kick-off meeting was held in March 2019, and the team is recruiting Technical Advisory Committee members, acquiring datasets, and engaging community stakeholders.

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Project Name: Port of San Diego Microgrid – Resiliency in Terminal Operations [EPC-17-049]	
Recipient/Contractor: San Diego Unified Port District (Port of San Diego)	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 6/13/2018 to 3/31/2023
Program Area and Strategic Objective: Technology Demonstration and Deployment S14: Take Microgrids to the Next Level: Maximize the Value to Customers.	
Issue: California ports are electrifying their operations to move toward zero emission operations. The migration to all-electric terminals will result in many terminals at least tripling their peak power consumption, while becoming more susceptible to operational disruptions due to losses of grid power. Renewable microgrids provide a potential path to a carbon-free, resilient, and sustainable energy solution while reducing the effects on the utility's distribution system. Demonstration of the operational and financial viability of a repeatable microgrid model will add significant value to California ports, while helping to increase DER penetration in a market.	
Project Description: The District proposes to develop a new, permanent, renewable microgrid at the Tenth Avenue Marine Terminal that can be replicated at other seaport terminals and distribution facilities throughout California, the U.S., and internationally. The project will incorporate solar photovoltaic renewable generation, battery energy storage, energy efficiency improvements, and a centralized microgrid controller to allow key elements of the terminal to remain operational when islanded from the electrical grid for a minimum of 12 hours. The proposed microgrid will test the integration of four distributed energy resources.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: The project will develop a solar-powered, resilient microgrid that will allow key elements of the terminal to remain operational for 12 hours or longer when islanded from the grid.	

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CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1b, 1c, 1h, 4a, 5b

Lower Costs:

The project will lower ratepayer costs by reducing the need for electric utility infrastructure improvement through consistent management of peak demand. The project will investigate different options for reducing capital investments and document the chosen least cost option for ratepayers implementing similar projects.

Greater Reliability:

The project will increase electric reliability by using solar + storage to provide local and reliable capacity and energy in one of San Diego Gas & Electric's highest density load centers.

Increase Safety:

The microgrid will increase energy resiliency resulting in a safer staging area that can be used for emergency relief, supplies, and fuel in the event of a disaster that causes a disruption to the electrical grid.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $4,985,272	**EPIC Funds Spent:** $0
Match Partner and Funding Split: The Regents of the University of California, San Diego: $201,963 (2.1 %) San Diego Unified Port District (Port of San Diego): $4,427,973 (46.1 %)	**Match Funding:** $4,629,936
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 54 out of 60 bidders	**Rank of Selected Applicant/ Bidder:** Group 1: Ranked # 5

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The project kick-off was held in June, 2018. The Port is in the early stages of identifying options for renewable energy, energy efficiency and energy storage to support microgrid design.

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Project Name:

Using Big Data to Holistically Assess Benefits from Building Energy System Transition Pathways in Disadvantaged Communities

[EPC-17-050]

Recipient/Contractor:

The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/11/2018 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S5: Reduce the Environmental and Public Health Impacts of Electricity Generation and Make the Electricity System Less Vulnerable to Climate Impacts.

Issue:

There is a lack of understanding on how to do energy planning in urban areas in California in a holistic way that considers multiple factors at the same time. This study is designed to developed an approach that could be duplicated to other urban areas.

Project Description:

This research project supports a holistic urban energy planning for the Avocado Heights community that considers, simultaneously, urban renewables, indoor and outdoor air quality, deep energy efficiency options, retrofit of homes and buildings, electrification, and environmental justice concerns.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Energy planning is usually conducted in a piecemeal fashion. For example, looking at opportunities for energy efficiency programs for the natural gas system or just looking at the transportation sector. This project, and other sister research projects, are taking a very different approach using a holistic approach for urban energy planning with the final goal of identifying economically attractive options for deep GHG reductions and improved environmental conditions.

CPUC Proceedings addressing issues related to this EPIC project:

Long-Term Procurement Proceeding (LTPP): R.13-12-010 [Closed] Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

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Applicable Metrics: CPUC Metrics- 4a, 4b

Lower Costs:

The research team is developing urban energy scenarios to estimate the best path forward to economically reduce greenhouse gas emissions and improve overall environmental conditions.

Environmental Benefits:

The research team is measuring indoor air quality conditions to determine if electrification would improve indoor air quality. In addition, they will estimate the best way to improve outdoor air quality and reduce GHG emissions in the urban area being studied.

Public Health:

The research team is measuring indoor air quality conditions to determine if electrification would improve indoor air quality. In addition, they will estimate the best way to improve outdoor air quality and reduce GHG emissions in the urban area being studied.

Assignment to Value Chain: Distribution	**Total Budgeted Project Admin and Overhead Costs:** $167,847
EPIC Funds Encumbered: $1,098,662	**EPIC Funds Spent:** $0
Match Partner and Funding Split: Regents of the University of California, Los Angeles: $54,740 (4.7 %)	**Match Funding:** $54,740
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

Funding Method: Competitive	**Funding Mechanism:** Grant	**No. of Initial Passing Applicants/ Bidders:** 28 out of 29 bidders	**Rank of Selected Applicant/ Bidder:** Group 2a: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: The research team has assembled a multi-disciplinary research team that has expertise in all required areas (e.g., public health, energy engineering, and public outreach). The research is in close contact with community-based representatives. This will allow the research team to elicit community perspectives during the execution of the project to determine what the community defines success.

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Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

LEED: A Lightwave Energy-Efficient Datacenter

[EPC-17-051]

Recipient/Contractor:

The Regents of the University of California, on behalf of the San Diego campus

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	6/18/2018 to 1/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Increasing the Power Utilization Efficiency (PUE) of a data center will not increase the overall datacenter energy efficiency. Further improvements in the energy efficiency of a datacenter require directly addressing the energy utilization of each server. Based on current trends, this is a challenging problem because the rate at which datacenter traffic is increasing is much larger than the rate at which packet switch chip bandwidth is increasing. This means that future datacenters will require more switch chips and constantly more power, to support the ever-increasing data rate.

Project Description:

The goal of this federal cost share grant, the Lightwave Energy-Efficiency Datacenter (LEED) program, is to at least double the current energy efficiency of a datacenter. This dramatic improvement is realized by increasing the energy utilization of each server by means of a novel lightwave network. The LEED network can substantially increase the network bandwidth which leads to a corresponding improvement in the server energy utilization. This improvement can be realized at a cost comparable to a state-of-the-art datacenter network based on conventional electrical switching technologies.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will lead technological advancement in lightwave technology for datacenters. It could double the efficiency of these datacenters by increasing the response speed and reducing energy input.

CPUC Proceedings addressing issues related to this EPIC project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 [Closed]

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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1c, 1f, 2a</td></tr>
<tr><td colspan="2">Assignment to Value Chain:
Demand-side Management</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:
$78,440</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:
$475,000</td><td colspan="2">EPIC Funds Spent:
$0</td></tr>
<tr><td colspan="2">Match Partner and Funding Split: N/A</td><td colspan="2">Match Funding:
$0</td></tr>
<tr><td colspan="2">Leverage Contributors:
U.S. Department of Energy: $3,800,000
The Regents of the University of California, San Diego: $491,524
Axalume: $127,000</td><td colspan="2">Leveraged Funds:
$4,418,524</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
43 bidders</td><td>Rank of Selected Applicant/ Bidder:
N/A</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The recipient tested the first design for the optical switch and began development of synchronization for the pinwheel switch and has also begun characterization of the devices for the interconnections. Recipient is on schedule.</td></tr>
</table>

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Project Name:

Urban Microgrids for Grid Resiliency and Disaster Readiness

[EPC-17-052]

Recipient/Contractor:

Gridscape Solutions

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/18/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Critical facilities such as fire stations and hospitals cannot afford to be without power even for a moment. The aging nature of the grid and limited funding for critical facilities operation have made disadvantaged communities particularly vulnerable and more susceptible to outages caused by natural disasters such as wildfire, severe weather, or earthquakes. Disadvantaged communities need better resilient infrastructure such as microgrids to help support critical operations.

Project Description:

The project will deploy microgrids at five disadvantaged community sites in Stockton, Fontana and Richmond. These sites include two fire stations, a police station, a 911 call center, and two emergency shelters such as Fontana City Hall and Richmond King Elementary School. The project will also develop a system capable of operating these five microgrids remotely. Each micrgrid will be able to operate independently to reduce facility electric costs and to island in the event of an emergency to keep critical operation running.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will lead to technological advancement and breakthroughs by developing and demonstrating the ability to remotely operate multiple microgrids, which can be useful for keeping all critical functions operational in the event of a grid outage, reducing utility costs, and minimizing the reliance on diesel backup generators.

CPUC Proceedings addressing issues related to this EPIC project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

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<table>
<tr><td colspan="4">Applicable Metrics: CPUC Metrics- 1a, 3h, 4a, 5a, 5b

Lower Costs:

This project will demonstrate the business case for applying microgrids to critical facilities, by showcasing the energy cost reductions that make these systems economical for local governments.

Greater Reliability:

This project provides orderly and multi-purpose integration of renewable generation at distributed sites, which benefits the ratepayer with greater reliability and resiliency at lower costs.

Increase Safety:

Each microgrid will be able to island during a utility outage or natural disaster such as an earthquake and provide emergency power to critical loads for more than 3 hours using renewable solar generation and battery storage technology.</td></tr>
<tr><td colspan="2">Assignment to Value Chain:

Distribution</td><td colspan="2">Total Budgeted Project Admin and Overhead Costs:

$0</td></tr>
<tr><td colspan="2">EPIC Funds Encumbered:

$4,995,498</td><td colspan="2">EPIC Funds Spent:

$119,958</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $429,752 (5.2 %)
TRC Energy Services: $10,074 (0.1 %)
InTech Energy, Inc.: $15,000 (0.2 %)</td><td colspan="2">Match Funding:

$3,281,992</td></tr>
<tr><td colspan="2">Leverage Contributors:

N/A</td><td colspan="2">Leveraged Funds:

$0</td></tr>
<tr><td>Funding Method:

Competitive</td><td>Funding Mechanism:

Grant</td><td>No. of Initial Passing Applicants/ Bidders:

54 out of 60 bidders</td><td>Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.</td></tr>
</table>

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Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.
Update: GridScape started the project in August and has begun developing the preliminary designs of the microgrids.

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Project Name:

Santa Rosa Junior College Urban Microgrid Project

[EPC-17-053]

Recipient/Contractor:

Sonoma County Junior College District/ Santa Rosa Junior College

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	7/18/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Microgrids have the potential to provide important resiliency benefits, especially in an area prone to natural disasters such as wildfires; however, it is difficult to justify their cost on resiliency alone. Academic campuses are particularly interested in maintaining critical functions in the event of a grid outage, notably during and after a natural disaster. The functions primarily support the students, faculty and staff but could provide support to the broader community. The challenge is building a business case for the development and deployment of a microgrid.

Project Description:

Santa Rosa Junior College (SRJC) is developing a microgrid demonstration project on campus. This project will integrate three types of distributed energy resource (DER) elements: solar photovoltaic (PV) generation, energy storage, and load reduction devices and load control systems, all managed by a single microgrid controller. The goals of this project are to meet 40% of the campus electricity requirement with emissions-free PV solar power, to reduce the campus peak load, to optimize energy use, to provide support services to the surrounding grid, and to create a highly resilient power system benefitting the campus and the community. The primary objectives of the project are to demonstrate the environmental, economic, and resiliency benefits of a highly flexible campus microgrid. Operational objectives encompass demonstration of power flow, load control, and energy storage in a large multi-building campus, operating at appropriate scale and in actual operating conditions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will result in advancements in the deployment of a microgrid, including the use of storage technologies, adaptive load management, and the monetization of microgrid assets while providing community support facilities in times of need. This project will also

demonstrate coordination of multiple large energy storage devices with different dynamic capabilities. By demonstrating a local approach to stabilizing utility grid frequency, the microgrid will be transformed from a source of load transients to a point of stabilization reaching far beyond the point of interconnection.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed]

Applicable Metrics: CPUC Metrics- 1c, 1g, 1h, 2a, 3f, 3h, 4a, 4b, 5a, 5b, 5d

Lower Costs:

The microgrid will lower costs of lost operation for the school by lowering peak demand charges and energy costs through on-site generation and storage. The project will reduce costs for the utility and ratepayers by providing local voltage support and frequency regulation, thus allowing the distribution grid to rely less on centralized local power electronics to provide these services.

Greater Reliability:

Power quality will be improved on both the college campus and local distribution system through demonstration of dynamic frequency regulation and voltage control technologies. With the ability to provide both real and reactive power and to respond autonomously to changing grid needs, the project will be capable of providing grid stabilization to the local distribution feeder. The project will provide back-up to the school in the event of an outage.

Increase Safety:

The project will provide back-up to the school campus in the event of grid outages, thereby improving the safety of staff, students, and potentially local residents.

Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $4,999,005	**EPIC Funds Spent:** $0
Match Partner and Funding Split: Sonoma County Junior College District/ Santa Rosa Junior College: $239,000 (1.7 %) SunPower Corporation, Systems: $8,450,759 (61.7 %)	**Match Funding:** $8,689,759

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<table>
<tr><td colspan="2">Leverage Contributors:</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
54 out of 60 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 3</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
Staff participated in a kickoff meeting at the Santa Rosa Junior College in Santa Rosa on October 26, 2018. On the same date, staff also participated in a public event hosted by the Local Government Sustainable Energy Coalition titled, "Disasters and Energy Resilience: Santa Rosa Junior College Microgrid Tour." This tour and discussion included a review of the current Santa Rosa Junior College microgrid design, completed microgrid infrastructure to date, and plans for future infrastructure integration.</td></tr>
</table>

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Project Name:

Rialto Resilient Clean Power Microgrid

[EPC-17-054]

Recipient/Contractor:

Rialto Bioenergy Facility LLC

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	8/31/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Presently, microgrid system deployment at facilities that manage wastewater, wastewater biosolids, or food waste, including through anaerobic digestion, is very uncommon. Microgrids have the potential to optimize onsite power management, enhance power export, and provide other grid and ratepayer benefits which can reduce the overall operational costs of these facilities and enable them to operate in the event of a grid outage. Additionally, California has a goal of diverting 75 percent of waste from disposal in landfills by 2020 called for by AB341; anaerobic digestion to convert waste into energy is part of the solution.

Project Description:

The project will install an advanced microgrid system that will include 2.0 MWh of battery electric storage, a 2.0 MW biogas-fueled cogeneration unit, and a microgrid control system at the Rialto Bioenergy Facility (RBF). The microgrid will manage the distributed energy resources to meet power demand loads at the RBF, while minimizing grid draw and enhancing renewable electricity export. Additionally, the microgrid will enable the operations to continue indefinitely in the event of a grid outage using availability of feed stock (i.e., food waste and biosolids).

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will demonstrate the business case for a microgrid that can improve operations of a food and biowaste treatment facility and wastewater treatment facility located in a disadvantage community. The microgrid will use a microgrid controller to optimize the use of a biogas cogeneration system, fueled by available feedstock, and working with energy storage to enable the facility to continue operations during a grid outage. This project will demonstrate the microgrid's ability to provide benefits to the residents of the disadvantaged community by providing opportunities to participate in demand response activities, providing cleaner air quality, and increasing grid reliability and resiliency. The business case could be

applicable to the 156 critical waste water treatment plants across California.

CPUC Proceedings addressing issues related to this EPIC project:

Energy storage: R.15-03-011 [Closed]

Applicable Metrics: CPUC Metrics- 1b, 1e, 1f, 1h, 4a, 4b, 4d, 4e, 5b, 5f

Lower Costs:

The microgrid will allow the facility to cut operating energy costs, which will make the economics of anaerobic digestion of food waste and biosolids more feasible in the state.

Greater Reliability:

The project is located near the end of the San Bernardino Corridor, a congested transmission system, and will provide distributed power resources to this area. Greater electricity reliability will result by implementing strategic load shaving and power production through demand response, minimizing peak power demand and by providing a local source of 2 MW of power. This will alleviate grid bottlenecking and enhance power supply resiliency and reliability to nearby disadvantaged communities.

Environmental Benefits:

The RBF will support diversion of food waste from landfills and enable the state to better utilize biosolids, rather than ship them to neighboring states for management; thus, reducing greenhouse gas emissions.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $0
EPIC Funds Encumbered: $5,000,000	**EPIC Funds Spent:** $0
Match Partner and Funding Split: The Grant Farm, Inc.: $80,000 (0.7 %) Trinity Consultants: $77,360 (0.7 %) GHD, Inc.: $5,000 (0.0 %) Rialto Bioenergy Facility LLC: $6,352,640 (55.2 %)	**Match Funding:** $6,515,000
Leverage Contributors:	**Leveraged Funds:** $0

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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	54 out of 60 bidders	Group 2: Ranked # 2
If not the highest scoring applicant/bidder, explain why selected: Funds were awarded to passing proposals in rank order.			
Treatment of Intellectual Property: Pre-existing intellectual property identified in agreement EPC-17-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.			
Update: Minor delays in getting subcontracts in place but work is now proceeding to make up time.			

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Project Name: Redwood Coast Airport Renewable Energy Microgrid [EPC-17-055]	
Recipient/Contractor: Humboldt State University Sponsored Programs Foundation	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 8/8/2018 to 3/31/2023
Program Area and Strategic Objective: Technology Demonstration and Deployment S14: Take Microgrids to the Next Level: Maximize the Value to Customers.	
Issue: As load serving entities, community choice aggregators (CCA) are required to procure utility scale renewable generation and energy storage to serve their customers. IOUs are transitioning to the grid of the future by updating interconnection processes while grappling with the effects of more and more intermittent renewable energy on the grid. Meanwhile climate change has increased the frequency and severity of natural disasters, highlighting the importance of keeping critical facilities operating to provide emergency services in times of dire need. The Redwood Coast Airport Microgrid Project will demonstrate a replicable business case for critical airport microgrids.	
Project Description: This project is a community scale renewable energy microgrid located at the Redwood Coast Humboldt County Airport. It will demonstrate the first multi-customer, front-of-the-meter microgrid with renewable energy generation owned by a CCA (Redwood Coast Energy Authority or RCEA) and the microgrid circuit owned by an IOU (PG&E). This microgrid will allow the CCA to participate in the CAISO wholesale electricity market and provide low carbon resilience to a commercial airport and U.S. Coast Guard Air Station, which are critical emergency facilities in Humboldt County.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: In order to manage increased DERs, California needs sophisticated DER management systems and strategies, and microgrids can play an important role in this regard. This project, with its innovative microgrid control architecture and DC-coupled, community scale solar PV/battery energy storage system designed for both end-use customer support and wholesale market participation, will lead to significant technological advancements and breakthroughs. Furthermore, PG&E will develop engineering standards, testing protocols, and equipment specifications for multi-customer, front-of-the-meter microgrids within their	

distribution system and RCEA as the CCA administrator will collaborate with PG&E to create experimental tariffs and agreements for development and operation of the microgrid. These tariffs and agreement will become important examples to other IOUs and CCAs.

CPUC Proceedings addressing issues related to this EPIC project:

Smart grid: R.08-12-009 [closed] Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1a, 1b, 1e, 1g, 1i, 2a

Lower Costs:

The solar PV array and battery storage system will lower annual energy purchases and lower average peak demand by using onsite renewable energy resources; thus, lowering costs.

Greater Reliability:

Reliability and resilience will be increased for the commercial airport and US. Coast Guard Air Station (two critical facilities). Because of the large PV array and storage battery, the microgrid will be able to supply nearly continuous power in the event of a prolonged emergency.

Increase Safety:

If grid power goes down, the microgrid will be able to island and provide electric power to the commercial airport and U.S. Coast Guard Air Station, which are critical emergency facilities in Humboldt County.

Economic Development:

The microgrid with 3100 MWh/yr of renewable electricity generation coupled with energy storage is estimated to generate an annual economic benefit of approximately $356,000. During the construction phase an estimated 37 full time jobs will be created, with $1.5M in earnings and $3.4M in economic output.

Environmental Benefits:

Over 3100 MWh/yr of renewable electricity will be generated. This is estimated to result in CO2 emission reductions of over 880 MT/yr.

Assignment to Value Chain:	**Total Budgeted Project Admin and Overhead Costs:**
Distribution	$407,963

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<table>
<tr><td colspan="2">EPIC Funds Encumbered:
$5,000,000</td><td colspan="2">EPIC Funds Spent:
$0</td></tr>
<tr><td colspan="2">Match Partner and Funding Split:
Redwood Coast Energy Authority: $5,996,358 (53.0 %)
Humboldt State University Sponsored Programs Foundation: $326,370 (2.9 %)</td><td colspan="2">Match Funding:
$6,322,728</td></tr>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
54 out of 60 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 3: Ranked # 2</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-17-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project kick-off meeting was held at the project site on August 10th. The Schatz Energy Research Center (SERC) executed subcontracts and developed a MOU between key project partners. In addition, SERC worked with the Redwood Coast Energy Authority (RCEA) to finalize a $6 million USDA loan package and with the Humboldt County Aviation Department to secure project approval from the Federal Aviation Administration. The project team worked to define the microgrid system architecture and started procurement negotiations for key components, including the battery energy storage system, solar PV system, and microgrid controls. SERC engaged with PG&E on distributed generator interconnection and worked with RCEA and PG&E on a set of microgrid operational responsibilities to support the first multi-customer microgrid in PG&E’s service territory.</td></tr>
</table>

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Project Name: Port Hueneme Navy Server Farm Building Microgrid [EPC-18-001]	
Recipient/Contractor: Electric Power Research Institute, Inc.	
Investment Plan: 2015-2017 Triennial Investment Plan	**Project Term:** 11/1/2018 to 3/31/2023
Program Area and Strategic Objective: Technology Demonstration and Deployment S14: Take Microgrids to the Next Level: Maximize the Value to Customers.	
Issue: Microgrids often experience system failures during transition between grid connected and islanding modes due to electric instabilities (e.g. unstable voltage, current, or power waveforms). Many of the controlling systems cannot recognize and respond to these rapid events. This is especially problematic for facilities that are sensitive to instabilities, such as data centers.	
Project Description: This project will demonstrate a standardized, high-penetration distributed energy resource (DER) microgrid to support a data center at the Naval Surface Warfare Center - Port Hueneme Division near Oxnard, CA. The data obtained on capital cost, operating cost, performance and lessons learned will support commercial deployment for both military and non-military applications.	
How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals: This project will develop new approaches to developing microgrids that can ensure stable power to sensitive components, such as in data centers. The team will demonstrate a standardized microgrid, analyze and define the savings and market barriers, and provide new, valuable performance data that will be used to develop a viable market for future deployments.	
CPUC Proceedings addressing issues related to this EPIC project: Energy storage: R.15-03-011 [Closed] Smart grid: R.08-12-009 [closed] Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 [closed] Smart Inverter: D.14-12-035 (in R.11-09-011) Integration of Distributed Energy Resources (IDER): R. 14-10-003 Greenhouse Gas Emission Allowance Cost and Revenue	

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Issues: R.11-03-012 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a

Lower Costs:

The collective use of installed on-site PV and battery energy storage system (BESS) will significantly reduce the need for the Southern California Edison (SCE) grid supplied energy and, in turn, will decrease the resulting cost of energy to the site. Furthermore, replacing the current leased lead-acid BESS with a permanent Li-ion BESS will save the site on leasing fees.

Greater Reliability:

The microgrid will allow the site to operate independently from SCE grid, supply power more efficiently from a localized source, and nullify the potential detrimental outcomes due to unforeseen power outages. The findings from this project will be leveraged to recommend a standardized design to improve the reliability of future microgrid integration in commercial applications.

Increase Safety:

The microgrid has the potential to increase safety due to improved ability to control and integrate the site's use of renewable power during islanding events. Curtailing the need to run the backup diesel generators will mitigate engine fatigue, failure, and maintenance caused during regular operation.

Assignment to Value Chain: Grid Operations/Market Design	**Total Budgeted Project Admin and Overhead Costs:** $848,609
EPIC Funds Encumbered: $4,998,345	**EPIC Funds Spent:** $0
Match Partner and Funding Split: Electric Power Research Institute, Inc.: $1,738,707 (20.5 %) Schweitzer Engineering Laboratories, Inc.: $1,537,028 (18.1 %) Distributed Utility Associates: $227,019 (2.7 %)	**Match Funding:** $3,502,754

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<table>
<tr><td colspan="2">Leverage Contributors:
N/A</td><td colspan="2">Leveraged Funds:
$0</td></tr>
<tr><td>Funding Method:
Competitive</td><td>Funding Mechanism:
Grant</td><td>No. of Initial Passing Applicants/ Bidders:
54 out of 60 bidders</td><td>Rank of Selected Applicant/ Bidder:
Group 1: Ranked # 6</td></tr>
<tr><td colspan="4">If not the highest scoring applicant/bidder, explain why selected:
Funds were awarded to passing proposals in rank order.</td></tr>
<tr><td colspan="4">Treatment of Intellectual Property:
Pre-existing intellectual property identified in agreement EPC-18-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.</td></tr>
<tr><td colspan="4">Update:
The project kick-off was held in December. The project team began engineering analysis for the development of the microgrid system design and coordinated these activities with the Naval Base Ventura County host site contact. The team will finalize the adaptive microgrid system architecture in the second quarter of 2019 and start procurement negotiations for key components.</td></tr>
</table>

APPENDIX B:
Project Write-Ups of All Active and Completed Energy Commission Electric Program Investment Charge Project Awards

Project Name:

California Test Bed Initiative

[EPC-18-002]

Recipient/Contractor:

California Clean Energy Fund dba CalCEF Ventures

Investment Plan:	**Project Term:**
2015-2017 Triennial Investment Plan	12/10/2018 to 3/31/2023

Program Area and Strategic Objective:

Market Facilitation

S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

In California, clean energy entrepreneurs and innovators experience significant difficulty making the leap from prototype to pilot scale demonstration of their technologies because they lack access to testing facilities and services to validate their products' design, safety and performance; and lack technical feedback to shift product specifications to meet the requirements of potential customers.

Project Description:

This project will develop and implement a voucher program to provide clean energy companies access to testing facilities to test and/or certify prototypes of pre-commercial distributed energy resource technologies, and help them refine their prototype to meet customer specifications. This project will start with an initial network of testing facilities that includes 29 University of California facilities from all ten campuses and two National Laboratory facilities. The project intends to grow this network throughout the duration of the project. This network of testing facilities will connect testing facilities throughout California, which would otherwise be disconnected, in order to serve clean energy companies more efficiently and effectively throughout all of California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

CalTestBed will accelerate new, clean, energy-efficient technologies to market and, as a result, reduce ratepayer costs. By early engagement of target customer groups in the refinement of product specifications and the evaluation of commercial viability, CalTestBed will accelerate the rate of development and commercialization of technologies that improve California's air, water and energy profile and drive economic investment, business creation and jobs.

APPENDIX B:
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CPUC Proceedings addressing issues related to this EPIC project: Integration of Distributed Energy Resources (IDER): R. 14-10-003	
Applicable Metrics: CPUC Metrics- 2a, 3a, 3b, 3e Increase Safety: CalTestBed develops and streamlines the feedback process among testbeds to meet customer safety specifications, as well as supporting the standardization of "customer-facing" services by testbeds to the innovation community. Through the CalTestBed Network, coordinates California testbeds to standardize safety testing and certifications and develop best practices for managing the testbed/entrepreneur relationship. Includes Customer Engagement elements to involve customer groups in evaluation of the safety of proposed technologies. Economic Development: CalTestBed will provide objective feedback to help entrepreneurs improve their products to meet customer needs, and grow into self-sustaining businesses. These services that CalTestBed will provide will increase the likelihood that clean energy companies can develop and scale their technologies and bring them to the market. Consumer Appeal: CalTestBed will provide the opportunity for target customer groups to give feedback to entrepreneurs letting them know what changes can be made to improve their products to meet customer needs.	
Assignment to Value Chain: Demand-side Management	**Total Budgeted Project Admin and Overhead Costs:** $610,684
EPIC Funds Encumbered: $10,999,701	**EPIC Funds Spent:** $0
Match Partner and Funding Split: California Clean Energy Fund dba CalCEF Ventures: $267,053 (2.2 %) University of California, Office of the President: $620,000 (5.2 %)	**Match Funding:** $887,053
Leverage Contributors: **N/A**	**Leveraged Funds:** $0

APPENDIX B:
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Funding Method:	**Funding Mechanism:**	**No. of Initial Passing Applicants/ Bidders:**	**Rank of Selected Applicant/ Bidder:**
Competitive	Grant	15 out of 15 bidders	Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This agreement was approved at the December 2018 Business Meeting. In 2019, the recipient will focus on developing and finalizing all materials, plans, and processes necessary to launch the CalTestBed voucher program. This will include creating materials and processes to solicit applications from clean energy companies for inclusion in the CalTestBed voucher program.

			Appendix C: EPIC Project Status Report									
Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	300-15-004 Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions	Applied Research and Development	This project is part of the U.S.-China Clean Energy Research Center for Water-Energy Technologies (CERC-WET), co-funded by the Department of Energy and the Government of China to partner on water-energy studies. This EPIC funded project Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions is one of three research endeavors addressing sustainable hydropower under a warming climate. The project develops an optimization model to ensure efficient hydropower operations, but this model will differ from existing models by taking into account different climate scenarios and regulatory constraints.	3/9/2016	No	Generation	$650,000	$650,000	$5,141	N/A	$5,141
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	300-15-005 Improving Hydrologic and Energy Demand Forecasts for Hydropower Operations with Climate Change	Applied Research and Development	The main focus of this research project is to develop grid-wide forecasts of inflows and electricity demands based on ground sensors and remotely sensed data, with emphasis on the effects from temperature fluctuations on electricity demands, hydrologic conditions, and grid performance. Furthermore, the project improves the accuracy of an existing near real-time Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) product, originally developed at UC Irvine's Center for Hydrology and Remote Sensing.	3/9/2016	No	Generation	$720,000	$720,000	$127,710	N/A	$127,710
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-006 Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack Prediction	Applied Research and Development	The purpose of this project is to fund research that reduces the stress on current water infrastructure in California. Research includes: (1) development of high water recovery desalination processes for non-traditional waters, (2) characterizing the potential for non-traditional water use in California, (3) development of recycled water scenarios for electricity generation, and (4) improving the characterization of California's snowpack.	3/9/2016	No	Demand-side Management	$1,130,000	$1,130,000	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	300-15-007** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	Applied Research and Development	The CalSEED Initiative helps develop California's next generation of clean energy entrepreneurs, providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough solutions that will benefit electric ratepayers in Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric service territories. Entrepreneurs receive funding in two stages: Concept Awards provide funding of up to $150,000 and are conducted through open solicitations; Prototype Awards provide funding of up to $450,000, but are only available to companies who have received a Concept Award.	3/9/2016	No	Demand-side Management	$9,788,043	$9,788,043	$4,321,594	N/A	$4,321,594

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
300-15-004 Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions	$114,054	$12,500,000	None	$0	0.0%	Contract-Interagency Agreement (The Regents of the University of California, Merced)	Pre-existing intellectual property identified in agreement 300-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Non-competitive	N/A	N/A	N/A
300-15-005 Improving Hydrologic and Energy Demand Forecasts for Hydropower Operations with Climate Change	$144,000	$12,500,000	None	$0	0.0%	Contract-Interagency Agreement (The Regents of the University of California, Irvine)	Pre-existing intellectual property identified in agreement 300-15-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Non-competitive	N/A	N/A	N/A
300-15-006 Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack Prediction	$198,000	$12,500,000	None	$0	0.0%	Contract-Interagency Agreement (The Regents of the University of California, Los Angeles)	Pre-existing intellectual property identified in agreement 300-15-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Non-competitive	N/A	N/A	N/A
300-15-007** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	$1,563,250	$0	California Clean Energy Fund dba CalCEF Ventures; Los Angeles Cleantech Incubator; Elemental Excelerator; The Grant Farm, Inc.; Umberg Zipser; Greenlining Institute;	$3,396,223	9.3%	Contract	Pre-existing intellectual property identified in agreement 300-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 7 bidders	California Clean Energy Fund dba CalCEF Ventures	Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
300-15-004 Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions	N/A	12/21/2015	Yes; Calif Based Entity	Prior studies of the trade-offs between electricity generation and environmental protection have been based on unrealistic optimization models that do not take real-world policy constraints, such as legal and regulatory limitations into account. The models produced by this research will for the first time create models to optimize hydropower generation that can take into account changes in precipitation and runoff due to a warming climate while sustaining downstream environments. These tools will inform decision-making in the context of trade-offs of electricity generation and environmental protection under a changing climate and relevant legal and regulatory constraints.	2a, 3a, 3f, 4d, 5c	The researchers have conducted a hydropower operators survey and are analyzing the submitted data. Survey results are anticipated in January 2019. The hydrologic modeling portion of the study is just underway. This project is on schedule to be completed before the end date of March 31, 2020.
300-15-005 Improving Hydrologic and Energy Demand Forecasts for Hydropower Operations with Climate Change	N/A	12/21/2015	Yes; Calif Based Entity	The advancement of tools for hydropower scheduling/prediction will facilitate power exchanges in the electricity markets, reduce unnecessary consumption of non-renewable energy sources, and increase the reliability of energy generation. California will be the study region so that the utility companies in California have the necessary support in their decision making process.	3f, 5c	The research team is continuing work to develop short-term precipitation forecasting framework for key regions in California with a lead time of up to 6 hours. In addition, the team designed a new framework of deep forecasting neural networks a Generative Adversarial Network (GAN) which will allow to forecast Cloud-Top Brightness Temperature (CTBT) and facilitate the generation of the spatial-temporal information that can be extrapolated for the future events. Furthermore, team is performing sensitivity analysis on the proposed Generalized Model Tree (GMT) framework. Researchers are currently testing multiple GMT algorithm settings for both benchmark data and real-case studies and in early 2019 will identify the optimal algorithm setting for simulating rule-based hydrologic systems (such as reservoir release simulation and operating rule reconstruction).
300-15-006 Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack Prediction	N/A	12/21/2015	Yes; Calif Based Entity	Research conducted will develop flexible, integrated approaches to reduce energy use and costs associated with the use of non-traditional waters, and minimize the volume of waste water produced from their treatment. In addition, the contract will provide guidance on the "best-fit" technologies for California based on geographic area, energy resources and water quality available. Additional research will provide reliability benefits include improving water forecasting scenarios pertaining to recycled water for electricity generation and snowpack forecasting for hydropower operations.	1f, 1h, 3a, 4a, 4c, 4d, 5a, 5c	The project is on track. The following are some updates: a) market characterization study of non-traditional waters: preliminary literature review is complete and the team is assessing sources of nontraditional waters for the full characterization. b) recycled water scenarios are almost complete and will soon be submitted for peer review; c) characterization of snowpack and snowmelt: preliminary results have been provided for CAM; d) the real-time snow-water-equivalent diagnostic models for the hydropower plants have been completed; e) for the desalination task, the team has tracked completed tracking of bench scale membrane performance and completed an analysis for CAM review.
300-15-007** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	N/A	N/A	None	CalSEED addresses a critical gap in the early technology development phase where small amounts of funding can have a significant impact in bringing new ratepayer-beneficial innovations to market by providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough clean energy solutions.	2a, 3e	The CalSEED Initiative was launched in January 2017 to provide seed grants of up to $150,000 for early-stage clean energy projects. In 2018, grants totaling over $2.6 million have been awarded to 18 entrepreneurs for a range of research projects including a phase change material that integrates into HVAC systems to reduce heating and cooling load by 25% and a magnetically stabilized liquid piston for more efficient compressed air energy storage. In total, 46 entrepreneurs have been awarded small grants under CalSEED. The first $450,000 Prototype Awards were awarded in January 2019, to the CalSEED entrepreneurs whose technologies have the strongest potential impact and commercial potential.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-007** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	Applied Research and Development	The CalSEED Initiative helps develop California's next generation of clean energy entrepreneurs, providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough solutions that will benefit electric ratepayers in Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric service territories. Entrepreneurs receive funding in two stages: Concept Awards provide funding of up to $150,000 and are conducted through open solicitations; Prototype Awards provide funding of up to $450,000, but are only available to companies who have received a Concept Award.	3/9/2016	No	Demand-side Management	$20,211,957	$20,211,957	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	300-15-008 Research Roadmap for Getting to Zero Net Energy Buildings	Applied Research and Development	Itron worked with Energy Commission staff to develop a gaps analysis that identifies, describes and prioritizes research, development, demonstration, and deployment (RDD&D) gaps that need to be addressed to achieve the state's goals for ZNE buildings in a safe, equitable and cost-beneficial manner. The gaps analysis was developed in consultation with stakeholders and subject matter experts through interviews, written comments, and public workshops.	4/13/2016	No	Demand-side Management	$999,884	$999,884	$464,762	N/A	$464,762
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	300-15-009** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	Market Facilitation	This contract will provide market analysis that will address the barriers that hamper commercial development of emerging energy technologies. Tasks under this work authorization contract could include tracking past and current award EPIC technology solutions to monitor successes, more accurately consider future EPIC funding opportunities, inform technology gap analyses, and develop online resources. The deliverables from this project will help prioritize future Energy Commission funding towards technologies that solve the addressed issues.	4/13/2016	No	Demand-side Management	$6,825,763	$6,825,763	$823,923	N/A	$823,923
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-009** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	Market Facilitation	This contract will provide market analysis that will address the barriers that hamper commercial development of emerging energy technologies. Tasks under this work authorization contract could include tracking past and current award EPIC technology solutions to monitor successes, more accurately consider future EPIC funding opportunities, inform technology gap analyses, and develop online resources. The deliverables from this project will help prioritize future Energy Commission funding towards technologies that solve the addressed issues.	4/13/2016	No	Demand-side Management	$112,126	$112,126	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	300-15-010 Research Roadmap for Advancing Technologies in California's Industrial, Agricultural, and Water Sectors	Applied Research and Development	Energetics Incorporated developed a technical assessment and gaps analysis to identify the research needs for advancing technologies in the IAW sectors. They collected information from literature searches and feedback from stakeholders and subject matter experts to identify critical needs and currently available emerging technologies. Together with Energy Commission staff, the team prioritized the technologies for key research, development, demonstration, and deployment areas. Finally, they incorporated the recommendations into a research roadmap that will help inform future EPIC investments for the IAW sectors.	5/17/2016	No	Demand-side Management	$647,728	$647,728	$546,723	N/A	$546,723

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
300-15-007** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	$0	$0	California Clean Energy Fund dba CalCEF Ventures; Los Angeles Cleantech Incubator; Elemental Excelerator; The Grant Farm, Inc.; Umberg Zipser; Greenlining Institute;	$0	0.0%	Contract	Pre-existing intellectual property identified in agreement 300-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 7 bidders	California Clean Energy Fund dba CalCEF Ventures	Ranked # 1
300-15-008 Research Roadmap for Getting to Zero Net Energy Buildings	$171,332	$0	None	$0	0.0%	Contract	Pre-existing intellectual property identified in agreement 300-15-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 6 bidders	Itron, Inc., dba IBS	Ranked # 1
300-15-009** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	$2,714,986	$0	None	$0	0.0%	Contract	Pre-existing intellectual property identified in agreement 300-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 4 bidders	Navigant Consulting, Inc.	Ranked # 1
300-15-009** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	$0	$0	None	$0	0.0%	Contract	Pre-existing intellectual property identified in agreement 300-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 4 bidders	Navigant Consulting, Inc.	Ranked # 1
300-15-010 Research Roadmap for Advancing Technologies in California's Industrial, Agricultural, and Water Sectors	$122,646	$0	TSS Consultants; Energetics Incorporated; Taylor Biomass Energy, LLC; Renewable Oil International LLC;	$29,610	4.4%	Contract	Pre-existing intellectual property identified in agreement 300-15-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 4 bidders	Energetics Incorporated	Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
300-15-007** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	N/A	N/A	None	CalSEED addresses a critical gap in the early technology development phase where small amounts of funding can have a significant impact in bringing new ratepayer-beneficial innovations to market by providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough clean energy solutions.	2a, 3e	The CalSEED Initiative was launched in January 2017 to provide seed grants of up to $150,000 for early-stage clean energy projects. In 2018, grants totaling over $2.6 million have been awarded to 18 entrepreneurs for a range of research projects including a phase change material that integrates into HVAC systems to reduce heating and cooling load by 25% and a magnetically stabilized liquid piston for more efficient compressed air energy storage. In total, 46 entrepreneurs have been awarded small grants under CalSEED. The first $450,000 Prototype Awards were awarded in January 2019, to the CalSEED entrepreneurs whose technologies have the strongest potential impact and commercial potential.
300-15-008 Research Roadmap for Getting to Zero Net Energy Buildings	N/A	N/A	Yes; Calif Based Entity	This project analyzed the most critical RDD&D gaps that need to be addressed to achieve California's goals for ZNE buildings for all new construction of residential buildings by 2020 and commercial buildings by 2030. Results of the analyses will be used to strategically target future EPIC investments in a manner that provides optimal benefits to IOU electric ratepayers, and maximizes the use of public research and development investments.	3e	This project was completed in May 2018. As a result of this contract, Energy Commission staff have over 60 technology briefs for high potential technologies that require more research. The technology briefs identify research gaps as well as the cost and performance targets needed for broad adoption. This contract also produced a prioritization tool that dynamically sorts the technologies based on weights assigned to priorities such as electrification, impact to the grid, and technology readiness level. The final report is being prepared for publishing on the Commission website.
300-15-009** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	N/A	N/A	None	This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Recommendations resulting from this agreement will help the Energy Commission better direct EPIC Program technologies towards addressing customer needs and becoming widespread, commercially available products.	2a, 3e	The project team has fourteen work authorization projects that are either active, in development, or have been completed. These work authorizations assist Energy Commission staff to appropriately target investments in microgrids, energy efficiency technologies, low-income/disadvantaged community research, and other topics. Additionally, a currently active work authorization will create an online platform that will facilitate tailored connections between investors, entrepreneurs, customer adopters and field test sites, and mentors and community based organizations.
300-15-009** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	N/A	N/A	None	This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Recommendations resulting from this agreement will help the Energy Commission better direct EPIC Program technologies towards addressing customer needs and becoming widespread, commercially available products.	2a, 3e	The project team has fourteen work authorization projects that are either active, in development, or have been completed. These work authorizations assist Energy Commission staff to appropriately target investments in microgrids, energy efficiency technologies, low-income/disadvantaged community research, and other topics. Additionally, a currently active work authorization will create an online platform that will facilitate tailored connections between investors, entrepreneurs, customer adopters and field test sites, and mentors and community based organizations.
300-15-010 Research Roadmap for Advancing Technologies in California's Industrial, Agricultural, and Water Sectors	N/A	N/A	Yes; Calif Based Entity	This project analyzed the most critical R&D gaps in the industrial, agricultural, water and bioenergy sectors that need to be addressed to achieve California's goals for doubling energy efficiency by 2030. Results of the analyses will be used to strategically target future EPIC investments in a manner that provides optimal benefits to IOU electric ratepayers, and maximizes the use of public research and development investments.	2a, 3e	The project ended in May 2018. Energetics conducted additional surveys and webinars to get stakeholder input on high-impact emerging technologies, the barriers to market entry for these technologies, as well as actions that can support market entry, and the success indicators. Feedback from 249 surveys and 19 webinars was analyzed and incorporated into a final research roadmap. The roadmap identifies critical technology gaps, possible solutions, and analysis for six major technology areas: industrial processing, industrial facilities, industrial power, agriculture, bioenergy, and water and wastewater. Energetics recommended a total of 123 energy-saving technologies that were prioritized for the six technology areas. Of these recommendations, 42 technologies are still in the RD&D stage. The roadmap will help inform the Energy Commission's future EPIC investments for the IAW sectors.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	300-15-011 California Commercial End-Use Survey	Market Facilitation	The Energy Commission conducted a CEUS in 2006, since then the energy landscape in California has changed dramatically including the deployment of advanced energy efficiency and renewable generation technologies. This project is updating the CEUS while adding additional granularity by (1) developing a methodology to conduct a survey of the characteristics of commercial utility customers that will serve as a baseline and support the Energy Commission's work on the demand forecast, (2) implementing the survey, and (3) providing an unbiased, comprehensive analysis of the data. When completed, the CEUS will provide a clearer picture of commercial energy end-use which will allow better strategic targeting of policies and incentives which will help facilitate the commercial success and market adoption of technologies, strategies, and other innovations.	5/17/2016	No	Grid Operations/Market Design	$7,990,063	$7,990,063	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-013 California Investor-Owned Utility Electricity Load Shapes	Market Facilitation	This project will develop analysis to characterize existing and future electricity load in the service territories of Pacific Gas and Electric Company, Southern California Edison Company, and San Diego Gas and Electric Company that will inform the Energy Commission's demand forecast. This information will, by including a mix of emerging energy trends and demand-side innovations, be used to identify and target opportunities to further reduce cost, improve safety, and improve reliability through clean energy technology research, development, deployment, and market facilitation opportunities.	6/14/2016	No	Grid Operations/Market Design	$1,147,406	$1,147,406	$464,770	N/A	$464,770
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	300-17-003 Distributed Energy Resources (DER) Roadmap	Market Facilitation	This project develops, in consultation with stakeholders and subject matter experts, a research roadmap that identifies, describes, and prioritizes key RDD&D needs to enable high penetration of distributed energy resources (DER). The roadmap will assess current status of DER in California; assess current research efforts, including those at the state and federal level; identify performance and cost targets and research needs; estimate rates for technology performance improvement, cost reduction, and adoption; develop methodology for prioritizing research needs in the near-, mid-, and long-term; apply methodology to research gaps to prioritize near, mid-, and long-term research needs; identify critical cost and performance indicators of success and methodology to estimate research benefits. Finally, the roadmap will Identify type and amount of data needed to advance DER policy and availability of DER financing, particularly for low-income customers; conduct public workshops; and document the roadmapping process.	5/9/2018	Yes	Demand-side Management	$499,065	$499,065	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	300-17-004 Measuring Innovation Progress to Guide Future Investment: Evaluation of EPIC Benefits Methodology	Market Facilitation	This project will provide guidance and independent analysis to develop a robust, standardized methodology to evaluate the electric ratepayer benefits attributable to EPIC-funded projects based on best-in-class methods, data, and analytical tools. This methodology will help the Energy Commission better understand how well the EPIC program is meeting its goals and removing barriers to further implementation of advanced technologies to meet the state's energy and climate policy goals.	5/9/2018	Yes	Demand-side Management	$3,000,000	$3,000,000	$49,280	N/A	$49,280

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
300-15-011 California Commercial End-Use Survey	$3,426,324	$0	ADM Associates, Inc.;	$100,893	0.8%	Contract	Pre-existing intellectual property identified in agreement 300-15-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	ADM Associates, Inc.	Ranked # 1
300-15-013 California Investor-Owned Utility Electricity Load Shapes	$430,673	$0	ADM Associates, Inc.;	$58,330	4.8%	Contract	Pre-existing intellectual property identified in agreement 300-15-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 5 bidders	ADM Associates, Inc.	Ranked # 1
300-17-003 Distributed Energy Resources (DER) Roadmap	$252,120	$0	None	$0	0.0%	Contract	Pre-existing intellectual property identified in agreement 300-17-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 5 bidders	Navigant Consulting, Inc.	Ranked # 1
300-17-004 Measuring Innovation Progress to Guide Future Investment: Evaluation of EPIC Benefits Methodology	$1,716,826	$0	None	$0	0.0%	Contract	Pre-existing intellectual property identified in agreement 300-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 3 bidders	Industrial Economics, Incorporated	Ranked # 1

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300-15-011 California Commercial End-Use Survey	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity	The CEUS will provide a more disaggregated sampling of the state's end-uses in the commercial sector, than was historically collected. This level of granularity will lead to more accurate energy forecasts which can assist in keeping rates low as forecasts are used to determine infrastructure needs in long term procurement planning by the CPUC. Furthermore, the data can assist the state in achieving the energy efficiency reduction goals outlined in Senate Bill 350 by supporting the identification and accurate characterization of opportunities for demand-side management, energy efficiency program planning, load shifting, and demand response.	1c, 2a, 5c	ADM negotiated non-disclosure agreements with the three California electric IOUs, to receive access to customer billing data necessary to conduct the survey. They also finalized the research plan, survey instrument and data collection protocols. The team began collection efforts with a sample pretest, to ensure the survey instrument and protocols worked, and made refinements to them as necessary. Surveyors were then trained and began collecting data in each of the IOU service territories in a staggered fashion, to optimize resources throughout the state. During various stages of the collection process, ADM performed monitoring and quality control of the data being submitted by the surveyors to: 1) identify incorrect or "out of range" entries, 2) analyze the data received, and 3) resolve sites with unusually high inconsistencies. Data collection will continue through 2019.
300-15-013 California Investor-Owned Utility Electricity Load Shapes	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity	DER technology has advanced significantly over the past decade and current loadshapes used to inform the Energy Commission's demand forecast do not account for the current and future deployment of demand-side innovations. Developing improved loadshapes will provide an accurate assessment of the contributions of clean energy technologies to reducing peak demand, integrating renewable energy, and maintaining electricity system reliability as the deployment of clean energy technologies and strategies increases over time. This information will be used to improve the Energy Commission's demand forecast and analysis, and identify and target opportunities for future EPIC research funding to further reduce cost, improve safety, and improve reliability.	1c, 5c	This project concluded in 2018. The Recipient developed updated baseline end-use load profiles and well as new load profiles characterizing electric vehicle use, photovoltaic use, and additional achievable energy efficiency. The Recipient also developed an updated version of the Hourly Electric Load Model. The Energy Commission's Energy Assessments Division will use this information to develop an annual peak forecast for the California Energy Demand (CED) forecasts, develop monthly peak forecasts for resource adequacy and CED forecasts, develop hourly forecasts to support peak shift analysis for annual peak forecasts, analyze various impacts, including AAEE and electric vehicles, to measure their impact on load shapes, and to provide end-user and other load shapes to outside stakeholders and other analysts.
300-17-003 Distributed Energy Resources (DER) Roadmap	N/A	N/A	None	This contract will fund efforts to strategically and effectively target future EPIC investments to maximize the use of public research and development investments. The resulting roadmap will identify and prioritize research on the most critical RDD&D technology gaps to enable transformation of the grid that increasingly integrates high-penetration of DERs that are needed to be address to achieve California's energy goals. The results of the analysis will provide further detail in the integration into utility planning and operational policies that are critical to the technological improvements and physical connections to the grid.	2a	The kickoff meeting was held on July 11, 2018. Subsequently, two separate Technical Advisory Committee (TAC) Meetings were held on September 11, 2018, and November 5, 2018 to seek inputs and feedback from TAC members on technical topic areas, literature sources, and metric development. The research team is in the process of finalizing the Literature Review component and is working on the development of the Technical Assessment of the DER technologies. Navigant anticipates hosting the first public workshop in Q1 2019 to seek comments on the draft Technical Assessment.
300-17-004 Measuring Innovation Progress to Guide Future Investment: Evaluation of EPIC Benefits Methodology	N/A	N/A	None	This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the state's statutory energy goals by standardizing the assessment of benefits to ratepayers of EPIC-funded projects.	3e	This project is completing its characterization of the EPIC program portfolio and reviewing information specific to each research area, including solicitations, grant agreements, and research roadmaps. The project team has held multiple meeting with EPIC research area leads to assess specific benefits priorities and challenges and to develop research-area specific logic models. The project team is conducting benefits literature review to explore available methods, data, and tools that can be incorporated into the methodology. The first major deliverable from this project to recommend improvements to the benefits methodology of the EPIC program is scheduled for June 2019.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	300-17-005 Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation	Market Facilitation	This project aims to develop a research roadmap to strategically frame research priorities, potential partnerships, and critical technology milestones to support EPIC portfolio decisions and accelerate progress toward more cost competitive, flexible and reliable renewable energy generation, operation, and storage.	5/9/2018	Yes	Generation	$338,059	$338,059	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-001 Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart	Applied Research and Development	This project aimed to reduce the operational uncertainty in both PV and net load forecasts by producing high accuracy forecasts and linking them to net load forecasts at finer time intervals. This increased accuracy in estimation and incorporation within net load forecasts will enable better integration of intermittent PV generation in California and lead to substantial savings in the associated wholesale energy market costs. The results of this agreement contribute to reduced operational uncertainty behind the Duck Chart by producing high accuracy solar generation forecasts for utilities and the CAISO, and linking these generation forecasts to methods for forecasting net loads at higher temporal resolution. This increased fidelity and connection to net load forecasts will provide critical insights to better manage the rapidly evolving grid in California.	12/10/2014	No	Generation	$998,926	$998,926	$741,596	N/A	$741,596
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-002 Investigating Flexible Generation Capabilities at the Geysers	Applied Research and Development	This project is investigating how the operation of Geysers geothermal facilities may be modified in order to address the greater demands imposed on the grid by the significant addition of intermittent resources. To do so, the project is developing an integrated model that simulates the effects of providing flexible operation on the reservoir, wells, pipelines, and power plants. The model is being tested at isolated wells, pipeline and power plant sites, and then at a cross-tied location, to determine the effects of flexible operation on the larger steam field. Results will be used to identify risks to structure and operations. Management and mitigation strategies needed to address specific flexible generation objectives will be identified and tested at a variety of representative problem areas. An evaluation of management strategies and costs will be developed to provide flexible generation and ancillary services.	12/10/2014	No	Generation	$3,000,000	$3,000,000	$2,082,595	N/A	$2,082,595
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-003 Low- Cost Thermal Energy Storage for Dispatchable CSP	Applied Research and Development	The purpose of this project is the development and demonstration of a cost-optimal, robust, and low-cost thermal energy storage (TES) fluid, elemental sulfur. Use of sulfur as a TES fluid will enable overall low system costs, long lifetime, and scalability for a wide range of concentrating solar power (CSP) applications and temperatures.	12/10/2014	No	Generation	$1,497,024	$1,497,024	$692,224	N/A	$692,224

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300-17-005 Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation	$86,365	$0	None	$0	0.0%	Contract	Pre-existing intellectual property identified in agreement 300-17-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	Energetics Incorporated	Ranked # 1
EPC-14-001 Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart	$268,243	$0	Clean Power Research; Itron, Inc., dba IBS;	$453,462	31.2%	Grant	Pre-existing intellectual property identified in agreement EPC-14-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Itron, Inc., dba IBS	Group 2: Ranked # 2
EPC-14-002 Investigating Flexible Generation Capabilities at the Geysers	$0	$0	Geysers Power Company, LLC; Multiple Equipment Suppliers; Multiple Mechanical Subcontractors; Reservoir Engineering Contractor;	$4,362,373	59.3%	Grant	Pre-existing intellectual property identified in agreement EPC-14-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Geysers Power Company, LLC	Group 3: Ranked # 1
EPC-14-003 Low- Cost Thermal Energy Storage for Dispatchable CSP	$198,528	$0	Southern California Gas Company;	$300,000	16.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	University of California, Los Angeles	Group 1: Ranked # 2

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300-17-005 Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation	N/A	N/A	None	This Research Roadmap aims to strategically frame research priorities, potential partnerships, and critical technology milestones to help inform EPIC RDD&D portfolio decisions and accelerate progress toward more cost competitive, flexible and reliable renewable energy generation, operation, and storage. A roadmap is the right tool for laying out RDD&D pathways. A robust roadmap considers a spectrum of technology complexity, the current state of the art, rapid expansion of scientific knowledge, competition for research and development (R&D) funding, dynamic customer expectations, and the high cost and risk of R&D.	2a	The project team is working on the development of the technical assessment of the grid connected renewable energy and storage technologies within California, which includes a literature review and feedback from subject matter experts in renewable energy systems. The project team has put together a list of experts in wind energy, solar energy, geothermal, small hydropower, bioenergy, storage and renewable integration from universities, research institutions, and public and private sectors, and has conducted more than 30 interviews with experts to prepare the assessment.
EPC-14-001 Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart	N/A	N/A	Yes; Calif Based Entity	The project showed that improvements in solar and net load forecasting methods can provide positive financial impacts in the scheduling and procurement of electricity in the wholesale electric market within the State. The results of this research have shown that, just in the period covered by this analysis, the potential savings to all stakeholders would have been on the order of $9 million. With further growth in solar and improvements in integrating behind the meter solar into the California ISO net load forecasts, the team anticipates it can achieve even greater cost reductions. This research sets the groundwork for further research on developing a framework to optimize the use of alternative forecasts by the California ISO into its net load forecast. It may be possible to develop a framework for choosing when to use the alternative forecast to optimize its value to all stakeholders.	1c, 4a, 5c	The project incorporated several forecast improvements by advancing methods for determining BTM system specifications and shading based on measured production inputs, integrating irradiance measurements to improve aerosol optical depth and cloud albedo aspects, and by incorporating near real-time metered PV generation data to fine-tune fleet forecasts of both grid-connected and BTM PV solar. Researchers evaluated three alternative model approaches for extending the CAISO load forecast framework and present the alternative load forecast frameworks for incorporating BTM solar PV forecasts. The study showed that improvements in solar and net load forecasting can provide positive financial impacts in the scheduling and procurement of electricity in the wholesale electric market within the State. The potential savings would have been on the order of $9 million just in the covered period.
EPC-14-002 Investigating Flexible Generation Capabilities at the Geysers	N/A	N/A	Yes; Calif Based Entity	The modeling work performed under this project resulted in successful development and application of a simulation-optimization framework for the optimal control of a steamfield under load curtailment. The framework can be used for different purposes. Specifically, response surfaces can be generated and visualized, providing valuable insights into the influence of interactions between control parameters. Steam wells with wellbore or corrosion risk problems can be addressed individually as needed, for example setting a minimum target flowrate on a well and adjusting automatically for changing pipeline pressures. More testing and development is needed in this area. Corrosion monitoring and mitigation is an ongoing major challenge. Strategies for dealing with corrosion will build upon current operating practices and R&D efforts.	2a, 4a, 5a, 5b	The project conducted a study to investigate flexible electrical generation capabilities at The Geysers. The overall objective was to define steam-field and power plant operating constraints and find ways to increase flexible generating capabilities. An integrated numerical model was developed to predict, study, and ultimately design strategies for flexible power generation. Field testing and modeling results show that steam well and pipeline corrosion is a major constraint on steam-field operations. High Chloride wells generally have Corrosion Mitigation Facilities (CMF) installed and are maintained at full flow. Upgrades installed during this study provided an incremental increase in existing flexible generation capabilities. Results from this study will guide economic evaluations and future capital improvements needed to expand current Geysers flexible generation capabilities.
EPC-14-003 Low- Cost Thermal Energy Storage for Dispatchable CSP	N/A	N/A	None	This project will develop a low-cost thermal storage fluid, elemental sulfur, which enables overall low system costs, long lifetime, and scalability for a wide range of concentrating solar power applications.	2a, 3a, 3b, 3h, 4a, 4b	The project has made significant progress including performing detailed heat transfer modeling and simulation, laboratory-scale material compatibility experiments, and laboratory-scale thermal battery testing. Results from the laboratory-scale (10 kWh capacity) system were very promising. The system was successfully operated at high temperature (600 degrees Centigrade) over multiple thermal cycles and demonstrated higher energy density and faster dynamic response (amount of time to charge and discharge) compared to conventional molten salt technology. A pilot-scale (30 kWh capacity) thermal battery system has been designed, built, and is being field tested using actual concentrating solar power as of December 2018. Testing the system in a real-world environment is critical to proving it can work with actual solar energy input.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-005 Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid	Applied Research and Development	This project aimed to integrate high-accuracy solar forecasting to optimize the operation of distributed energy resources, and utilize the value of solar forecasting in utility grid operations to improve grid reliability, reduce ratepayer costs and increase safety. The objectives were to apply forecasts to inform control and scheduling decisions for distributed energy resources with emphasis on energy storage and electric vehicle charging control at warehouse photovoltaic clusters in the LA-Orange-Riverside-San Bernardino-San Diego Counties as well as the UCSD microgrid.	12/10/2014	No	Generation	$999,984	$999,984	$726,345	N/A	$726,345
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-008 High-Fidelity Solar Power Forecasting Systems for the 392 MW Ivanpah Solar Plant (CSP) and the 250 MW California Valley Solar Ranch (PV)	Applied Research and Development	The purpose of this project to develop and validate tools capable of monitoring and forecasting DNI and POA irradiance and the power generation accurately, from 5 minutes out to 72 hours in the future, mainly at the Ivanpah Solar Thermal plant, but also at the California Valley Solar Ranch (CVSR) plant. The project also included the development of tools for predicting wind speed, which affects the heliostats' deployment, and the improvement of the power generation forecast via Resource-to-Power Model (RTP) for Ivanpah (CSP) and CVSR (Tracking PV) plants. The goal of this system is to reduce uncertainties associated with operation, regulation and scheduling.	12/10/2014	No	Grid Operations/Market Design	$999,898	$999,898	$695,921	N/A	$695,921
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-009 Optimizing Radiant Systems for Energy Efficiency and Comfort	Applied Research and Development	This project develops new design and operation tools for radiant cooling and heating systems in order to provide standardized guidance for radiant systems in commercial buildings. The agreement includes full-scale laboratory experiments, whole-building simulations, development of simplified models for radiant system controls, validation of these new methods in field studies, occupant satisfaction surveys, and an update to Title-24 for radiant systems. The project is expected to produce: 1) a simplified tool for calculating the cooling load and cooling capacity of a radiant slab system, including calculation methods with significant direct solar radiation, 2) a simplified online operational tool for radiant slab systems, and 3) updates to the Title 24 Alternative Calculation Method Reference Manual to enable improved modeling capabilities of radiant systems.	2/25/2015	No	Demand-side Management	$2,939,964	$2,939,964	$2,097,811	N/A	$2,097,811
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-010 Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation	Applied Research and Development	This project (a) quantifies the energy savings, peak demand reduction, urban cooling, and air quality improvements attainable from cool walls in California; (b) assesses the performance of existing cool wall technologies, develops innovative cool wall solutions, and (c) facilitates collaboration among government agencies, utilities, and industry to create a cool-wall infrastructure that includes application guidelines, a product rating program, incentives, and building code credits.	2/25/2015	No	Demand-side Management	$2,500,000	$2,500,000	$2,500,000	N/A	$2,500,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-011 From the Laboratory to the California Marketplace: A New Generation of LED Lighting Solutions	Applied Research and Development	This project focuses on the design and development of innovative LED lighting solutions for three key general illumination product categories. These solutions are a best-in-class medium, screw-base replacement lamp, linear tubular light emitting diode (TLED) replacement lamps and spectrally optimized, dedicated LED luminaires. Product design requirements are based on consumer light quality and functional performance preferences determined through a series of unique laboratory-based consumer preference and product characterization studies.	2/25/2015	No	Demand-side Management	$2,995,187	$2,995,187	$1,691,723	N/A	$1,691,723

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EPC-14-005 Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid	$157,282	$0	San Diego Gas and Electric Company; Itron, Inc. dba IBS; University of California, San Diego, San Diego Supercomputer Center; Strategen;	$999,984	50.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	The Regents of the University of California, San Diego	Group 2: Ranked # 1
EPC-14-008 High-Fidelity Solar Power Forecasting Systems for the 392 MW Ivanpah Solar Plant (CSP) and the 250 MW California Valley Solar Ranch (PV)	$168,624	$0	Itron, Inc. dba IBS; NRG Energy, Inc.;	$764,019	43.3%	Grant	Pre-existing intellectual property identified in agreement EPC-14-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	The Regents of the University of California, San Diego	Group 2: Ranked # 3
EPC-14-009 Optimizing Radiant Systems for Energy Efficiency and Comfort	$450,466	$0	Center for the Built Environment - UC Berkeley; Price Industries;	$299,194	9.2%	Grant	Pre-existing intellectual property identified in agreement EPC-14-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	The Regents of the University of California on behalf of the Berkeley campus	Group 1: Ranked # 2
EPC-14-010 Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation	$908,941	$0	_3M; BEHR; Metal Construction Association; PPG Industries; Saint-Gobain; Sherwin Williams; Tex-Cote; Valspar;	$610,800	19.6%	Grant	Pre-existing intellectual property identified in agreement EPC-14-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 3
EPC-14-011 From the Laboratory to the California Marketplace: A New Generation of LED Lighting Solutions	$557,072	$5,000	Regents of the University of California, Davis - California Lighting Technology Center;	$5,000	0.2%	Grant	Pre-existing intellectual property identified in agreement EPC-14-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Regents of the University of California, Davis - California Lighting Technology Center	Group 1: Ranked # 4

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-005 Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid	N/A	N/A	Yes; Calif Based Entity	The uncontrollable generation of renewable energy sources, such as solar photovoltaics poses numerous challenges to the electric grid. The large growth of electric vehicles (EV) has potential to exacerbate those challenges due to increases in load, especially at inopportune times. However, the flexibility of scheduling EV charging around forecasted PV production provides a solution to this problem. Furthermore, the project improved solar energy forecast accuracy by 10% over the existing persistence forecast method for 10 minute ahead to optimize the operation of distributed energy resources. It will mitigate the concerns of electric operations over the variable nature of solar power that contributes to net load variability, causing voltage issues affecting service quality and reliability.	1c, 4a, 5c	The utility customers who use solar forecasting and smart EV charging could achieve a 67% reduction in energy costs over the year, reducing monthly peak demand by 63%. This study reveals that using aggregated vehicle load large enough to absorb the solar output on the studied circuit is years in the future. The studied circuit showed that connected PV output created an energy valley of 64.5 MWh. Using a typical commuter PEV requiring 7 kWh means that roughly 9,200 vehicles must be connected during the solar output period to create an adequately sized energy sink to absorb the full amount of this oversupply. The executive order B-48-18 will improve the perspectives for EV charging and grid net load balancing in California. But at 929,000 commercial buildings in California, Oregon, and Washington, even 250,000 chargers will fall short of the amounts required in this example.
EPC-14-008 High-Fidelity Solar Power Forecasting Systems for the 392 MW Ivanpah Solar Plant (CSP) and the 250 MW California Valley Solar Ranch (PV)	N/A	N/A	Yes; Calif Based Entity	This project introduced a new generation of forecasting methods that fill in a technology gap in prediction DNI, POA irradiance and solar power generation from PV tracking and CSP. This critical need is evident by the relative scarcity of DNI forecasting algorithms discussed in scientific literature and the absence of DNI information from the majority of NWP models. The development of a network of low-cost sensors for distributed monitoring at California Valley Solar Ranch (CVSR) provides a solution to the need for high-density ground telemetry at low cost. The devices provide an unprecedented level of irradiance sensor density, which will be used to develop a new generation of solar forecasting methods. Short-term forecast using sky imagers and distributed data from sensor network improved forecasted data and prepared CVSR for the California ISO intra-hour market.	1c, 4a, 5c	The project demonstrated that the forecasting accuracy for DNI and POA irradiance across all time-scales (intra-hour, intra-day, day-ahead) can be improved using forecasting models that blend local and remote telemetry. The project results demonstrated the importance of having a rich set of input data to improve forecasting. This effect was more important for the intra-hour time scale, in which multiple solar sensors, sky images, high-resolution satellite images, are essential to reduce forecasting errors. The tools developed were used in two very distinct testbeds (Ivanpah and CVSR) to predict irradiance and power generation. In both cases, the forecasting accuracy was improved relative to baseline models. The models were successfully applied to other locations, showing that they can be used in other grid-connected solar farms. The final report was submitted and it is in review process.
EPC-14-009 Optimizing Radiant Systems for Energy Efficiency and Comfort	N/A	N/A	Yes; Calif Based Entity	Radiant systems can be an integral part of ZNE and other advanced high performance buildings and reduce energy and peak energy use and cost compared to conventional HVAC systems.	1e, 1f, 1h, 4a	Field study reports for all three sites were submitted. The project team has completed all major data collection and monitoring activities. The project team is finishing a software tool for modeling radiant systems and is expected to be completed in early 2019. The draft final report is anticipated in early 2019.
EPC-14-010 Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation	N/A	N/A	Yes; Calif Based Entity	The project is advancing scientific knowledge by quantifying the potential benefits of cool walls, assessing the performance of existing and prototype cool wall technologies, and developing innovative cool wall solutions. High wall albedo can be attained with a reflective coating (e.g., paint or stucco) or cladding. Cool wall products available today include light-colored paints that reflect up to 80% of sunlight when new, but may lose reflectance as they soil; and darker cool colored paints that come in a wide palette, but typically reflect less than 50% of sunlight when new. This project will provide information to building owners, facility managers, and the paint industry on the direct and indirect energy and environmental benefits of solar reflecting walls, assessing and advancing available and emerging cool wall tech	1e, 1f, 1h, 4a, 5d	The project has been completed. The findings from this project indicate that cool walls can reduce whole-building annual HVAC use by up to 25% in single-family, 3.7% in medium offices, and 9% in stand-alone retail stores. The final report will be published in January 2019.
EPC-14-011 From the Laboratory to the California Marketplace: A New Generation of LED Lighting Solutions	N/A	N/A	Yes; Calif Based Entity	This project could improve understanding of metrics and test procedures associated with LED quality and performance, increase lamp manufacturer's ability to comply with future energy codes and standards and produce good quality LED products and increase consumer acceptance and satisfaction of LED lamps.	1f, 1h, 4a	The recipient completed a lamp characterization report which included a survey on consumer interests in LED lamps and controls, information on lighting performance and functional experiment on three classes of LED lamps. Preliminary results indicate that consumers are concerned about energy savings, and those who participated in the study want higher CRI lamps even though the lamps produce 13% less light output. The full report is posted at https://cltc.ucdavis.edu/. The recipient is working with manufacturers interested in collaborating on new LED lamp development such as optics, quality and architecture. The recipient is partnering with UC Irvine to study consumer acceptance of LED lamp prototypes to assess color, flicker, noise and overall performance for healthcare applications. The draft final research report will be available in February 2019.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-012 Comparing Attic Approaches for Zero Net Energy Homes	Applied Research and Development	The project focused on the performance of different attic assemblies and their associated heating, ventilating and air conditioning (HVAC) systems. Field measurements of attic and HVAC system performance were conducted in two new high performance homes in California with sealed and insulated attics. One home was built to be about 30 percent better than Title 24 and the other is a ZNE home. The attic insulation approach involved a new lower-cost approach using blown insulation that does not use expensive spray-foam. The results of the measurements are used directly to provide technical support for potential changes to Title 24 and provide information to contractors and builders on sealed and insulated attic performance and alternative approaches.	2/25/2015	No	Demand-side Management	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-013 Very Low-cost MEMS-based Ultrasonic Anemometer for Use Indoors and in HVAC Ducts	Applied Research and Development	This project develops and tests prototype room and duct anemometers that are low-cost, low power, accurate, calibration-free and compact. The anemometers are wireless, able to be inexpensively installed in existing buildings, can operate on a battery for years and communicate wirelessly via the internet to the building's control system. The technology is expected to save energy by using collected data to correct wasteful HVAC malfunctions that result in inefficient systems and uncomfortable buildings.	2/25/2015	No	Demand-side Management	$2,488,964	$2,488,964	$1,406,967	N/A	$1,406,967
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-015 Direct Current as an Integrating and Enabling Platform	Applied Research and Development	This project evaluates DC and AC-DC hybrid applications to determine market segments where projects are technically and economically feasible. The research covers existing and new buildings. For the market segments identified, the Team is developing and piloting tools to help building developers incorporate these systems into their building designs. The tools include DC and AC-DC hybrid design guidelines, and design templates.	2/25/2015	No	Demand-side Management	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-016 Cost- and Energy-Efficient Attic Designs for California Homes	Applied Research and Development	This project evaluates, tests and refines two different attic designs in California homes, and recommends the best approaches to home builders addressing cost-effectiveness and energy-efficiency. The baseline will be the current energy efficiency code practices for ventilated roof attics with no additional attic insulation and ducts within the attic that comply with the current energy code (2013) requirements for ducting.	2/25/2015	No	Demand-side Management	$1,000,000	$1,000,000	$774,029	N/A	$774,029
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-017 Developing Flexible, Networked Lighting Control Systems That Reliably Save Energy	Applied Research and Development	The recipient is developing low-cost lighting components with open communication interfaces, that allow seamless integration into whole-building control and automation systems. The project targets future California Building Energy Efficiency Standards (Title 24), and establish methods by which the site-specific configuration and operation of networked lighting controls systems can be effectively addressed, and more easily implemented in the marketplace.	2/25/2015	No	Demand-side Management	$1,875,000	$1,875,000	$1,875,000	N/A	$1,875,000

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-012 Comparing Attic Approaches for Zero Net Energy Homes	$563,439	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 1
EPC-14-013 Very Low-cost MEMS-based Ultrasonic Anemometer for Use Indoors and in HVAC Ducts	$595,177	$0	Center for the Built Environment - UC Berkeley; BAF Technologies Inc.; Vigilent; Chirp Microsystems, Inc.; Price Industries;	$249,000	9.1%	Grant	Pre-existing intellectual property identified in agreement EPC-14-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	The Regents of the University of California on behalf of the Berkeley campus	Group 1: Ranked # 1
EPC-14-015 Direct Current as an Integrating and Enabling Platform	$495,365	$0	EMerge Alliance; California LMCC IBEW-NECA;	$100,000	9.1%	Grant	Pre-existing intellectual property identified in agreement EPC-14-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1
EPC-14-016 Cost- and Energy-Efficient Attic Designs for California Homes	$228,148	$0	Owens Corning;	$265,000	20.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	BIRA Energy	Group 3: Ranked # 2
EPC-14-017 Developing Flexible, Networked Lighting Control Systems That Reliably Save Energy	$216,162	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 6

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-012 Comparing Attic Approaches for Zero Net Energy Homes	N/A	N/A	Yes; Calif Based Entity	This project will lead to technological advancement by offering alternative construction techniques for sealing and insulating attics, compared to conventional methods. The alternative technique involves the use of sealed attics and could lead to electricity savings and peak demand savings when compared to conventional duct systems, and also increase occupant comfort. The recipient is working with building developers on these new techniques which will contribute to achieving ZNE goals for new construction. The techniques can also be applied to home retrofits with HVAC equipment.	1f, 1h, 4a	Staff is reviewing the final report and a final project presentation occurred on 12/19/18. The Fresno test home was monitored continuously from September 2016 to the end of April 2018, and the Clovis test home was monitored from June 2017 through mid-May 2018. The Fresno home exceeds California Title 24 energy performance requirements by 30%, while the Clovis home is designed as a net zero-energy home. Over 100 sensors were installed per home, monitoring temperature, relative humidity, heat flux, surface condensation, moisture and HVAC energy use. An improved version of a sophisticated and mature model called Register Capacity (REGCAP) was used to extend results to all of California's 16 climate zones. Preliminary results indicate an average of 18 percent savings in HVAC energy use using these approaches.
EPC-14-013 Very Low-cost MEMS-based Ultrasonic Anemometer for Use Indoors and in HVAC Ducts	N/A	N/A	Yes; Calif Based Entity	The ability to accurately control airflow with these low cost sensors can expand the comfortable temperature setpoint range in air-conditioned buildings, such as allowing the setting higher indoor temperatures while still being comfortable. This can facilitate more efficient operation of building HVAC systems, resulting in an estimated savings of 183 GWh/yr and 52,000 metric tons CO2e/yr.	1f, 1h, 2a, 3a, 4a	This project is nearing completion. The team has developed prototypes of both a duct air flow sensor, and a room air flow sensor, both of which were demonstrated at an industry advisory board meeting in October 2018. The team is testing the prototypes and the final report is being reviewed.
EPC-14-015 Direct Current as an Integrating and Enabling Platform	N/A	N/A	Yes; Calif Based Entity	The potential energy savings and interoperability advantages of DC and AC-DC hybrid systems are estimated to be significant, especially for zero net energy (ZNE) buildings that integrate on-site renewable energy with battery storage and electric vehicle (EV) charging. Prior research estimates energy savings potential of 10% to 30% for DC-powered ZNE buildings that incorporate storage and or EV charging. This project will help accelerate the adoption of DC and AC-DC hybrid applications by compiling existing knowledge, identifying standards and technology gaps, designing tools and identifying a path forward to help ensure successful outcomes for DC and AC-DC hybrid applications in key market segments from which these systems can scale.	1f, 1h	The project is complete. Results indicate that no technology breakthroughs are needed to make DC power distribution a viable option for zero net energy buildings. There are, however, many barriers to the adoption of DC power, with product availability and cost as the most significant ones. There also is a general unfamiliarity with DC power in the building community, from designers to code officials, contractors, tradespeople, maintenance staff, building owners, occupants, and policy makers. The recipient indicates that there is a real need for DC power market development in the form of product standards, building and fire codes that explicitly account for DC systems, DC specific design practices, improved trade familiarity, and a wider variety of DC ready products in a range of product categories, feature sets and capacities. The final report will be published in January 2019.
EPC-14-016 Cost- and Energy-Efficient Attic Designs for California Homes	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity	Methods to improve the efficiency of building envelopes have included sealed, insulated attics as well as standard vented attics but are in limited use in the market today. However, these approaches add considerable cost to builders under current practices. The research team is employing new and novel installation methods and materials, which include low cost fiberglass insulation with boxed netting and integral vapor retarder, that have the potential for energy savings on par with ducts in the conditioned space, but at a cost similar to current construction practices.	1f, 1h, 4a	The recipient instrumented three existing homes in the City of Rio Vista with the following attic approaches: Vented with R-38 on the ceiling, Sealed with box netted R-38 under roof deck, and vented with R-38 on the ceiling and R-19 under roof deck. The monitoring started in August 2018. Unfortunately, the grant expired on June 30, 2018. The Energy Commission staff and the recipient are exploring options for obtaining the monitored data and results for the homes and concluding the project.
EPC-14-017 Developing Flexible, Networked Lighting Control Systems That Reliably Save Energy	N/A	N/A	Yes; Calif Based Entity	The research focus is on how low cost sensing and distributed intelligence can enhance energy efficiency and enable distributed points of controls that result in greater energy savings and more accurate energy reporting. The research will result in the design and development of a new innovative desk lamp with localized sensing and user control of overhead ambient lighting. This innovative technology alters the lighting retrofit landscape by inexpensively enabling highly granular lighting control at the occupant's fingertips (previously only zone-level control existed), to control overhead lighting. In addition, this technology can be enhanced with sensors to measure occupants circadian lighting exposure to enable system control to ensure human health and productivity is optimized while maximizing energy efficiency attributes.	1f, 1h, 4a	The project is on track to complete all deliverables. Standard data models for connected lighting systems were developed. Communication protocols, methodologies, metrics and control testing for the outcome-based lighting systems are complete. Testing of Enlighted's networked lighting control system is occurring at FlexLab, and will compare reported data types. Draft proposed content for user interface standards was circulated to industry in September 2018 for comments. Draft final report anticipated January 2019.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-021 Development and Testing of the Next Generation Residential Space Conditioning System for California	Applied Research and Development	This project is designing and testing a residential heat pump space-conditioning system at 3 homes across California. The advanced efficiency solutions integrated into the HVAC system will include: variable-capacity compressor and variable-speed fans using state-of-the-art inverter technology; integrated ventilation to harness fresh air for "free cooling;" intelligent dual-fuel technology to decrease energy cost and empower consumers to choose between electricity and natural gas; zonal control to prevent conditioning of unoccupied rooms; demand-response interactivity to grid flexibility and reliability; advanced fault detection and diagnostics to ensure proper installation, operation, and maintenance; and alternative refrigerants for improved operation and significant reductions in the potential for global warming.	4/8/2015	No	Demand-side Management	$2,993,005	$2,993,005	$1,437,829	N/A	$1,437,829
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-022 The Lakeview Farms Dairy Biogas - To - Electricity Project	Technology Demonstration and Deployment	ABEC #3 LLC, DBA Lakeview Farms Dairy Biogas is installing and demonstrating an innovative covered lagoon digester system that will process dairy manure into biogas to generate renewable electricity for export to the electricity distribution grid. This particular project is located near 11 other dairies and will help launch the state's first "hub-and-spoke" dairy digester cluster by preparing the 1 MW generator platform to accept 2 MWs of future capacity potentially utilizing biogas from neighboring dairies and providing a means to off-take gas for vehicle fuel use. This hub and spoke approach was initially proposed in a case study prepared for the USDA on the economic feasibility of dairy digester clusters in California. The idea is to allow the dairies to benefit from the aggregation of capital investment and reduce operation and management costs by centrally locating the generators and associated electrical equipment.	3/11/2015	No	Generation	$4,000,000	$4,000,000	$3,733,835	N/A	$3,733,835
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-023 Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits	Applied Research and Development	Eos is performing pilot testing of a 125 kW/375 kWh AC-integrated energy storage system consisting of approximately 140 Eos Znyth (Trademark) battery modules. The system is being installed at PG&E's testing facility in San Ramon, CA. System performance is being characterized against a variety of use cases including peak shaving, ancillary services, load following, and frequency regulation. Eos is modeling a portion of PG&E's distribution network to create simulated grid conditions that will allow for dynamic testing of the battery storage system.	4/8/2015	No	Distribution	$2,156,704	$2,156,704	$1,517,558	N/A	$1,517,558
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-024 Modular Biomass Power Systems to Facilitate Forest Fuel Reduction Treatment	Applied Research and Development	This project develops and tests a modular biomass gasification system that can be rapidly deployed to communities across California to promote and support fire-safe management activities.	3/11/2015	No	Generation	$2,000,000	$2,000,000	$1,507,302	N/A	$1,507,302
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-025 Mass-manufactured, Air Driven Trackers for Low Cost, High Performance Photovoltaic Systems	Applied Research and Development	The project aimed to install and test a 300 kW photovoltaic solar system with air driven trackers. Two key technical innovations were demonstrated. First, the use of mass-manufacturing for the drive system results in an extremely low cost structure and very low part count. Second, only tubing is connected to each actuator, removing requirements for outdoor wiring or individual control hardware. The research involved collecting six months of performance data for the solar PV tracking technology.	3/11/2015	No	Generation	$1,000,000	$1,000,000	$636,136	N/A	$636,136

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-021 Development and Testing of the Next Generation Residential Space Conditioning System for California	$1,072,105	$0	Electric Power Research Institute, Inc.;	$322,281	9.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 8
EPC-14-022 The Lakeview Farms Dairy Biogas - To - Electricity Project	$32,107	$0	ABEC #3 LLC, dba Lakeview Farms Dairy Biogas;	$4,500,000	52.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	ABEC #3 LLC, dba Lakeview Farms Dairy Biogas	Group 3: Ranked # 1
EPC-14-023 Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits	$691,504	$0	Electric Power Research Institute, Inc.; Eos Energy Storage, LLC;	$1,167,607	35.1%	Grant	Pre-existing intellectual property identified in agreement EPC-14-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Eos Energy Storage, LLC	Group 2: Ranked # 1
EPC-14-024 Modular Biomass Power Systems to Facilitate Forest Fuel Reduction Treatment	$330,466	$0	TSS Consultants; West Biofuels, LLC ; Christiana Darlington; Soper-Wheeler Co. LLC;	$730,148	26.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	West Biofuels, LLC	Group 1: Ranked # 1
EPC-14-025 Mass-manufactured, Air Driven Trackers for Low Cost, High Performance Photovoltaic Systems	$157,497	$0	PV Evolution Labs; Sunfolding, Inc. ;	$1,171,565	54.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Sunfolding Inc.	Group 4: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-021 Development and Testing of the Next Generation Residential Space Conditioning System for California	N/A	N/A	Yes; Calif Based Entity	This project will develop a climate optimized HVAC system that includes advanced energy efficiency features integrated into a single unit. The technology could reduce electricity use, demand and costs, enhance occupant comfort, and allow the use of alternative refrigerants that reduce the potential for global warming.	1e, 1f, 1g, 1h, 4a	There are three test sites for this project, one in each electric IOU territory. Data collection is underway and will continue to be collected until early 2019.
EPC-14-022 The Lakeview Farms Dairy Biogas - To - Electricity Project	N/A	N/A	Yes; Calif Based Entity	The project will significantly reduce methane emissions and generate renewable electricity helping to achieve the State's GHG emission reductions and renewable electricity goals. Demonstrating the effectiveness of the innovative hub and spoke model could lead to the development of more California dairy digester biogas-to-electricity and biogas-to-fuels projects. The improved digester design will decrease dairy operating costs and provide valuable co-products, such as nutrient-rich, more absorbable irrigation water.	3a, 4a, 4e	The project broke ground in fall 2016 and construction is complete. A TAC was held in October 2017 followed by a CPR in November. The project accepted a PG&E 20-year Power Purchase Agreement and began testing in fourth quarter 2017 with full operation and data collection commencing in the first quarter of 2018. A ribbon cutting event was held in February 2018. The project is operating and continuing data collection for a year.
EPC-14-023 Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits	N/A	N/A	None	Eos is the only company offering a zinc hybrid cathode battery, under the trademark name Znyth. This is an aqueous, zinc-based battery technology that is inherently safer than competing technologies. This technology is non-flammable and non-toxic. In addition to being backed by UL- and ISO-certified quality assurance and control, the manufacturing process involves no toxic or hazardous materials. This demonstration will provide information and data to assess the value and cost savings of utility-scale battery energy storage when interconnected to the grid.	1c, 1i, 2a, 4a, 5b	Major milestones accomplished in 2018 include battery installation, system commissioning, system operation and monitoring, and data review for Eos' first generation system. Based on key learnings from the Generation 1 system, Eos developed the Generation 2 system which will be installed and commissioned for testing and evaluation in 2019. The Generation 2 system will be their commercial deployment model.
EPC-14-024 Modular Biomass Power Systems to Facilitate Forest Fuel Reduction Treatment	N/A	N/A	Yes; Calif Based Entity	This project is driving innovation in the bioenergy market for forest residue conversion to renewable grid power by advancing the modular gasification technology system design and integration with a high-efficiency lean-burn engine. The modular system has the potential to reduce the cost and increase the benefits of forest fuel reduction projects in high fire risk regions of the state. The project sought a technological solution to support California goals including healthy forest management, protection of electricity infrastructure, and production of renewable electricity.	1a, 1c, 4a	The project yielded important results that did not support the initial hypothesis that the recipient's CircleDraft gasification system was appropriate for the California market. However, the project did result in the development of a more robust modular system (rotary gasifier integrated to an Organic Ranking cycle (ORC) generator) that addressed critical technical challenges experienced with the initial system including material flow issues associated with forest material, associated producer gas output and quality fluctuations, and high engine generator maintenance requirements. Based on testing done with match funds, the rotary gasifier + ORC generator configuration is ready for a commercial technology demonstration in a California forest sector community.
EPC-14-025 Mass-manufactured, Air Driven Trackers for Low Cost, High Performance Photovoltaic Systems	N/A	N/A	Yes; Calif Based Entity	The PV solar tracking technology tested and validated in this project will result in ratepayer benefits of reduced cost of energy and increased energy supply reliability. The air driven trackers not only reduce the direct product cost to the customers, but also simplify every step in the project lifecycle (i.e., development, construction, and operation). The reduced cost of energy will be achieved by the innovative solar tracking technology that adds 15-25% more power over fixed tilt systems at a cost that is well below the cost of current solar trackers. The increases in energy supply reliability will be achieved by delivering additional power that occurs in the late afternoon to the grid.	2a, 3b, 4a	Sunfolding successfully installed the 300kW PV tracker in the field, which is currently operating at PVUSA. The field was fully instrumented and analysis of system performance data demonstrated that it meets or exceeds industry standards for tracking accuracy, uptime, and availability, which are key metrics to meeting solar industry bankability requirements. Sunfolding's tracker accuracy was calculated based on standards in IEC 62817. The analysis involved data cleaning, correcting wind speed to meet standards, dividing data into high and low wind speed based on a 4 m/s threshold, and filtering data based on nautical twilight. The project team also evaluated the pneumatic system using pressure sensors and a series of tests in the field and in simulations, which have strongly improved the understanding of the system and effect of changes in pressure and position on tracker performance.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-028 Low Cost Biogas Power Generation with Increased Efficiency and Lower Emissions	Applied Research and Development	This project deploys a pre-commercial technology demonstrating a sorbent-based biogas purification process for combined heat and power generation at the pilot scale that removes multiple troublesome impurities from biogas, upgrading the fuel to near-pure methane for combustion in conventional prime movers. The pilot plant will be installed and tested at a brewery wastewater plant and at a landfill site to demonstrate the environmental and cost benefits of biogas purification prior to use in combined heat and power applications.	3/11/2015	No	Generation	$1,318,940	$1,318,940	$352,393	N/A	$352,393
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-029 The West Star North Dairy Biogas-to - Electricity Project	Technology Demonstration and Deployment	This project advances digester design by building and demonstrating an innovative, double-cell covered lagoon digester and 1-megawatt (MW) generation system. The system will convert dairy manure into biogas and store the biogas above the primary and secondary lagoons under an inflatable cover. The biogas will be converted into renewable electricity and sold for export to the PG&E distribution grid. Further, dairy biogas systems qualify for participation in the CPUC's Assembly Bill (AB) 2514 electricity storage program. In a future phase, the biogas system may compete for an energy storage contract. The project will also improve groundwater protection by minimizing leaching of manure into the groundwater	3/11/2015	No	Generation	$4,000,000	$4,000,000	$3,938,867	N/A	$3,938,867
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-030 Paths to Sustainable Distributed Generation Through 2050: Matching Local Waste Biomass Resources with Grid, Industrial, and Community Levels	Applied Research and Development	This project highlights locations where waste biomass can be used most efficiently and sustainably for distributed generation by developing scenarios through 2050 that identify the most promising opportunities for waste biomass DG, identifying key technical and regulatory hurdles to waste biomass DG utilization, developing tools for matching available waste biomass resources with energy production opportunities, and suggesting solutions for achieving cost parity with fossil fuels.	3/11/2015	No	Generation	$1,500,000	$1,500,000	$1,500,000	N/A	$1,500,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-031 Pollution Control and Power Generation for Low Quality Renewable Fuel Streams	Technology Demonstration and Deployment	The project proposed to use a 250 kW gas turbine system that converts relatively dirty, low heating value fuels into heat using gradual oxidation. This gradual oxidation technology was developed by Ener-Core, a California company, and has been demonstrated in operating systems for well over 500 hours, but has not yet been commercially deployed in California. The site for the demonstration was a closed landfill producing low quality gas that is currently flared. This site was a good match for the 250 kW demonstration as it eliminates the need for flaring of the otherwise unusable gas while generating electricity.	4/8/2015	No	Generation	$1,499,386	$1,499,386	$1,020,425	N/A	$1,020,425
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-032 Capturing Cultural Diversity in California Residential Energy Efficiency Potential: An Energy Ethnography of Hispanic Households	Market Facilitation	This project focused on reaching Hispanic subpopulations in California to better understand the social, cultural, and behavioral aspects of their decisions to adopt energy efficient technologies and behaviors. The study combined data collected from participants via energy usage journals, in-home interviews, and energy meters to further the knowledge of Hispanic cultural associations and beliefs related to energy use decisions and choices. The information gathered in this study can be used to improve the metrics and assumptions underlying energy demand forecasting and energy efficiency potential and goals studies. In addition, the study provided information that can be used for targeted marketing of energy efficiency programs to the Hispanic population and improved levels of service to these households.	4/8/2015	No	Demand-side Management	$224,593	$224,593	$224,370	N/A	$224,370

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-028 Low Cost Biogas Power Generation with Increased Efficiency and Lower Emissions	$105,570	$0	ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.; Waste Management of California, Inc.; InnoSepra, LLC;	$959,150	42.1%	Grant	Pre-existing intellectual property identified in agreement EPC-14-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	InnoSepra, LLC	Group 2: Ranked # 4
EPC-14-029 The West Star North Dairy Biogas-to - Electricity Project	$32,107	$0	ABEC #2 LLC, dba West Star North Dairy Biogas;	$5,000,000	55.6%	Grant	Pre-existing intellectual property identified in agreement EPC-14-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	ABEC #2 LLC, dba West Star North Dairy Biogas	Group 3: Ranked # 2
EPC-14-030 Paths to Sustainable Distributed Generation Through 2050: Matching Local Waste Biomass Resources with Grid, Industrial, and Community Levels	$670,276	$0	Energy Bioscience Institute; Allotrope Partners; PepsiCo R&D;	$282,000	15.8%	Grant	Pre-existing intellectual property identified in agreement EPC-14-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 3
EPC-14-031 Pollution Control and Power Generation for Low Quality Renewable Fuel Streams	$145,560	$0	Advanced Power and Energy Program (APEP) - University of California, Irvine; ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.; Ener-Core, Inc.;	$438,345	22.6%	Grant	Pre-existing intellectual property identified in agreement EPC-14-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	University of California, Irvine	Group 1: Ranked # 1
EPC-14-032 Capturing Cultural Diversity in California Residential Energy Efficiency Potential: An Energy Ethnography of Hispanic Households	$10,681	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	Inova Energy Group, LLC	Ranked # 3

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-028 Low Cost Biogas Power Generation with Increased Efficiency and Lower Emissions	N/A	N/A	Yes; Calif Based Entity	The project is advancing an innovative gas cleanup system based on temperature swing adsorption concept that adsorbs carbon dioxide and other contaminants while letting methane pass through and that regenerates the adsorbent bed leading to lower cost of operation. Converting biogas to high purity biomethane enables its use in premium efficient devices for power generation thereby helping reduce the cost of electricity. This technological approach will help meet renewable electricity goals at a lower cost and will enable use of marginal biogas sources for power generation applications using conventional natural-gas fired prime movers.	1a, 1b, 3g, 4a, 4b	InnoSepra's gas conditioning system was upgraded and delivered to the Simi Valley landfill in September, 2018. After repairing some minor damage incurred during transport, the system has been functioning as designed, and the project team has focused on accumulating hours of operation. InnoSepra is currently negotiating with MillerCoors and a second company for a second demonstration using digester gas, but those negotiations are not yet complete.
EPC-14-029 The West Star North Dairy Biogas-to - Electricity Project	N/A	N/A	Yes; Calif Based Entity	This project demonstrates an improved digester design with the double cell lagoon for greater biogas storage and on-demand generation potential and, if successful, establishes dairies as competitors for storage contracts. The improved system will decrease dairy and digester operating costs while also enhancing the protection of groundwater. Other important benefits include: lowered manure handling costs and valuable co-products, such as nutrient rich, more absorbable irrigation water.	3a, 4a, 4e	The project broke ground in fall 2016 and construction is complete. A TAC was held in October 2017, followed by a CPR in November 2017. The project accepted a 20-year PG&E BioMAT Power Purchase Agreement and is collecting data, including full operation commencing in the first quarter of 2018. Project is collecting operational data for a full year.
EPC-14-030 Paths to Sustainable Distributed Generation Through 2050: Matching Local Waste Biomass Resources with Grid, Industrial, and Community Levels	N/A	N/A	Yes; Calif Based Entity	This analysis (1) identifies high-priority areas within California and feedstock types for further public deployment funding, (2) highlights promising geographic areas or available technologies to encourage increased investment in waste biomass DG by the private sector, and (3) improves efficiency and reduces environmental burdens by helping to minimize biomass transportation distances and maximize the efficiency of power production and waste heat utilization.	3c, 4a	The researchers developed 2020 (near term) and 2050 (long term) scenario projections for waste biomass supply in California. Four TAC meetings were held to identify the scope and scale of waste heat and waste heat-generated cooling for customers in the domestic, commercial, and industrial process markets. The project has developed a county-level monthly wet and dry California biomass inventory, assessed the energy generation potential from food waste in California and identified counties where new anaerobic digestion capacity is needed. The researchers estimated energy demand density and identified areas with district heating/cooling potential by using building stock turnover model along with energy use intensity factors. The project developed a biositing tool, is matching biomass types and evaluating costs associated with relevant energy generation technologies.
EPC-14-031 Pollution Control and Power Generation for Low Quality Renewable Fuel Streams	N/A	N/A	None	If the project was successful, it would have demonstrated and deployed a novel gradual oxidation system in conjunction with a gas turbine that is capable of converting low-grade, and otherwise unusable, landfill biogas into renewable electricity.	1a, 1c, 3a, 3h, 4a, 4b	Site engineering, drawings, and permitting requirements were completed in early 2016. An interconnection study with two supplemental reviews was completed by Southern California Edison in late 2016. The study identified the need for substation upgrades and an interconnection cost which far exceeded the budgeted amount. Consequently, the project sought a new landfill host site to demonstrate the novel gradual oxidation technology. A new site (with an existing interconnection agreement) was found and confirmed in mid-2017. However, the equipment installation continued to be delayed due to issues with a major subcontractor and the equipment developer for the project, Ener-Core. In December 2018, Energy Commission staff learned that due to funding issues, Ener-Core was not able to move forward with the project. A stop work order was issued in December 2018.
EPC-14-032 Capturing Cultural Diversity in California Residential Energy Efficiency Potential: An Energy Ethnography of Hispanic Households	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of the Hispanic subpopulation that discourage or prevent their participation.	1f, 1h, 5c	This project was completed in 2018. Key findings show that participants' energy-related behaviors were heavily influenced by family and community. For example, extended family members living under the same roof lead to variances in energy behaviors. Subtler implications include the use of energy to prioritize comfort for elderly family members. The study also found that participants did not tend to focus on the technical capabilities of energy-efficiency equipment or home envelope improvements, instead the focus was on behavior. For example, participants reported manually turning on and off their air conditioners rather than relying on the thermostat. The results of this project have been shared with IOU energy efficiency program managers and community based organizations to help increase Hispanic participation in energy efficiency programs.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-033 North Fork Community Power Forest Bioenergy Facility Demonstration	Technology Demonstration and Deployment	The North Fork Forest Bioenergy project is constructing and demonstrating a 1 megawatt (MW) forest waste bioenergy gasification-to-electricity facility in the foothills of the Sierra Mountains. The biomass gasification facility is targeted to be a commercial-scale, community-based facility capable of accepting and processing wood waste from forest management that would otherwise create wildfire and air quality challenges, and generating renewable grid-connected electricity. Once the gasification is fully installed and operational, the project will investigate critical performance parameters including best practices and evaluating individual components and protocols to improve performance and reduce operating costs.	4/8/2015	No	Generation	$4,965,420	$4,965,420	$3,225,772	N/A	$3,225,772
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-035 Demonstration of integrated photovoltaic systems and smart inverter functionality utilizing advanced distribution sensors	Applied Research and Development	The research project is developing, demonstrating, and evaluating at the pilot scale the ability of an integrated, advanced PV and storage system at a state-of-art test bed in the LBNL Facility for Low Energy Experiments (FLEXLAB). The system includes smart inverter control to enhance and optimize grid support and system performance. The strategy evaluates the use of distribution synchrophasor unit data to support specific visualization and control applications on distribution circuits. The project includes a 13 to 15 kilowatt (kW) PV electric generating system and a 14 kW (56 kW-hour) battery storage installation at FLEXLAB.	4/8/2015	No	Grid Operations/Market Design	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-036 Smart Inverter Interoperability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage	Applied Research and Development	The project is developing a complete solution of smart solar PV-based DER system that addresses key barriers impeding the progress towards high penetration of solar and DER. The work includes development of a CA Rule 21 test framework and test scripts; compliance testing of smart inverters with functionality as described in the CPUC CA Rule 21 Smart Inverter Working Group (SIWG) recommendations; monitor and control inverter operating functions including participation in ancillary service for diverse DER assets; increase of photovoltaic (PV) penetration and cost effectiveness while enhancing safety and reliability of the California grid. This agreement will deliver a smart inverter test framework and open source software tools to enable rapid product development and safety testing and will demonstrate the benefits to all stakeholders including ratepayers, utilities, manufacturers, investors and operators.	4/8/2015	No	Grid Operations/Market Design	$2,000,000	$2,000,000	$943,930	N/A	$943,930
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-037 Home Energy Efficiency Retrofits in California: An Analysis of Sociocultural Factors Influencing Customer Adoption	Market Facilitation	This project conducted a multidisciplinary, data driven study to understand the role and interactions of various factors influencing the adoption and utilization of residential energy efficiency measures. The study provided awareness into the stand alone and interactive effects of factors such as income, ethnicity, language, and political orientation on the adoption of energy efficient technologies, with a primary focus on the Latino population in the Fresno area. Knowledge gained from this study can be used to enhance energy policy and program design to account for social, cultural, and behavioral factors.	4/8/2015	No	Demand-side Management	$599,924	$599,924	$570,017	N/A	$570,017
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-038 Fieldwork to Document Technology Adoption and Behavior Change Across Diverse Geographies and Populations to Inform Energy Efficiency Program Design	Market Facilitation	This project uses empirical research methods grounded in anthropology and other social and behavioral sciences to explore the factors affecting behavior beyond simple economic rationale. This practice is achieved by documenting and analyzing emerging attitudes, emotions, experience, habits, and practices around technology adoption for purposes of devising predictive indicators for on-going potential studies regarding energy consumption in California.	4/8/2015	No	Demand-side Management	$574,545	$574,545	$459,714	N/A	$459,714

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EPC-14-033 North Fork Community Power Forest Bioenergy Facility Demonstration	$87,680	$0	TSS Consultants; The Watershed Research and Training Center; North Fork Community Development Council; Phoenix Energy; Yosemite Sequoia Resource Conservation and Development Council; Western Energy Systems; USDA Forest Service - Sierra National Forest; Kamaleah Deshi;	$1,361,360	21.5%	Grant	Pre-existing intellectual property identified in agreement EPC-14-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	The Watershed Research and Training Center	Group 4: Ranked # 1
EPC-14-035 Demonstration of integrated photovoltaic systems and smart inverter functionality utilizing advanced distribution sensors	$375,000	$0	Tesla, Inc.;	$25,000	2.4%	Grant	Pre-existing intellectual property identified in agreement EPC-14-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Lawrence Berkeley National Laboratory	Group 4: Ranked # 3
EPC-14-036 Smart Inverter Interoperability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage	$162,005	$0	SunSpec Alliance; Kitu Systems;	$2,066,875	50.8%	Grant	Pre-existing intellectual property identified in agreement EPC-14-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	SunSpec Alliance	Group 3; Ranked # 1
EPC-14-037 Home Energy Efficiency Retrofits in California: An Analysis of Sociocultural Factors Influencing Customer Adoption	$166,993	$0	Renovate America;	$214,000	26.3%	Grant	Pre-existing intellectual property identified in agreement EPC-14-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	Center for Sustainable Energy	Ranked # 4
EPC-14-038 Fieldwork to Document Technology Adoption and Behavior Change Across Diverse Geographies and Populations to Inform Energy Efficiency Program Design	$40,208	$0	Indicia Consulting; California State University San Marcos;	$52,500	8.4%	Grant	Pre-existing intellectual property identified in agreement EPC-14-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	Indicia Consulting	Ranked # 5

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-033 North Fork Community Power Forest Bioenergy Facility Demonstration	N/A	N/A	Yes; Calif Based Entity	This commercial-ready gasification technology has not been previously demonstrated in California. Combined with the producer gas cleanup system, automation and control, and optimized operation, this innovative system will prove distributed, woody biomass-fueled electricity to be economically feasible and capable of operating for 7,000 hours a year. The project will be grid-connected and will provide immediate benefits including increased renewable generation capacity, expanded technical resources, and community environmental, wildfire, and economic development benefits.	1a, 1c, 2a	A Stop Work Order was put in place in September 2017 to halt expenditures while waiting for an executed power purchase agreement and for equipment to be delivered to the project site. The power purchase agreement with PG&E was approved in November 2017. As of December 2018, the project received approval to issue bonds for debt underwriting. Staff expects that financing will be finalized and construction/installation will resume in January 2019. The agreement term has been extended to March 2020.
EPC-14-035 Demonstration of integrated photovoltaic systems and smart inverter functionality utilizing advanced distribution sensors	N/A	N/A	Yes; Calif Based Entity	The project will advance a breakthrough technology, a smart inverter with embedded synchrophasor, that is scalable across investor-owned utility territory leading to well coordinated and managed high-density PV installations and ratepayer benefits of greater reliability, lower costs, and increased safety.	1e, 2a, 3c, 3d, 3f, 4a, 5b	The project built a central infrastructure and models for power systems study, mitigation strategies and control schemes with focus on California. All models and a library of recorded grid events are open-source and available to the research community. This project is pushing the state of the art by developing a new controller architecture based on model predictive control (MPC) methods to provide optimal control of the entire system of battery storage, PV system, and the building load, subject to a variety of power constraints, with the objective of minimizing the total energy cost for the customer. The controller was field tested and improved for a total of about 3 months. This project found that additional research is needed on the potential of dynamic change of smart inverter set points to better support the grid during critical situations.
EPC-14-036 Smart Inverter Interoperability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage	N/A	N/A	Yes; Calif Based Entity	Smart inverters testing scripts for CA Rule 21 Phase 1 compliance were developed under this project. Testing proved that smart inverters made by different manufacturers perform CA Rule 21 Phase 1 autonomous functions in a manner consistent with the UL 1741 SA standard, thus increasing interoperability across PV system configurations and expanding customer choice. Project results proved that 100%+ renewables into the California grid is technically feasible, in combination with rapidly declining costs driven by global market efficiencies make state-level clean energy targets achievable and proved conclusively that smart inverters compliant with CA Rule 21 Phase 1 requirements can be installed safely at penetration levels of 100% or higher. Knowledge gained played a key role in the development of the Common Smart Inverter Profile that forms the basis of CA Rule 21 Phase 2 compliance.	1b, 3d, 3f, 4a, 5b	This project developed open source test scripts for evaluating compliance to UL 1741 Supplement A. A total of five inverter brands were evaluated using SunSpec System Validation Platform (SunSpec SVP) and associated test scripts at the UC San Diego advanced function inverter test labs. Both lab and field testing proved that smart inverters respond in the same way as simulated when controlled through communication networks. Results showed that very high grid penetration levels by DER are technically feasible such that they far surpass the 15% limitation previously claimed to maintain grid balance and stability.
EPC-14-037 Home Energy Efficiency Retrofits in California: An Analysis of Sociocultural Factors Influencing Customer Adoption	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of the Hispanic subpopulation that discourage or prevent their participation.	2a, 5c	CSE's analysis of 704 records sample revealed that using brochures with imagery of modest houses and families that appeared Hispanic (as opposed to imagery of large homes and non-Hispanic, Caucasian families) had a positive impact on sign-up rates in census tracts with a high concentration of Hispanics. Despite this increased number of sign-ups, phone interviews with 30 self-identified Hispanic participants found few had completed or planned major upgrades based on the energy audit recommendations, though minor upgrades like weather-stripping or light bulb replacements were more common. These results highlight the importance of tailoring outreach materials for energy efficiency programs, and the efficiency potential that can be accessed through improved program outreach.
EPC-14-038 Fieldwork to Document Technology Adoption and Behavior Change Across Diverse Geographies and Populations to Inform Energy Efficiency Program Design	N/A	N/A	None	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of various subpopulations that discourage or prevent their participation.	1f, 1h, 5c	The project is on schedule. All deliverables have been submitted. Reviewer comments have been provided on the draft Final Report. The Final Report will be published in January 2019.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-040 Self-Tracking Concentrator Photovoltaics for Distributed Generation	Applied Research and Development	This research develops, tests, and demonstrates a self-tracking concentrator photovoltaic (ST-CPV) system, a new concentrator photovoltaic technology that does not require a precision mechanical tracker to keep it aligned to the sun. The ST-CPV panel contains a thin layer of fluids that passively responds to the changing solar angle, automatically adjusting optical pathways within the device to ensure that incident sunlight is captured and concentrated over a wide range of angles. The passive internal tracking allows ST-CPV panels to be mounted in a stationary configuration or with a simple single axis tracker. This makes the system highly economical, greatly reduces installation and maintenance complexity, and enables distributed generation with higher efficiency CPV modules.	5/13/2015	No	Generation	$999,940	$999,940	$863,465	N/A	$863,465
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-041 Installation of a Lean Burn Biogas Engine with Emissions Control to Comply with Rule 1110.2 at a Wastewater Treatment Plant in South Coast Air Quality Management District	Technology Demonstration and Deployment	This project aimed to design, build and install a continuously operating commercial scale emissions reduction system for the lean burn biogas engine(s) at a municipal wastewater treatment plant in Palm Springs California. If successful, the project would have enable lean burn biogas engines to comply with existing and future air quality regulations when deployed at wastewater treatment plants, resulting in reduced flaring and net reductions in emissions.	4/8/2015	No	Generation	$2,249,322	$2,249,322	$11,858	N/A	$11,858
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-044 Enabling Anaerobic Digestion Deployment for Municipal Solid Waste-to-Energy	Technology Demonstration and Deployment	The purpose of this project is to enable environmentally and economically sustainable deployment of technology that transforms organic municipal solid waste into heat, electricity, and compost via dry anaerobic digestion. A dry anaerobic digestion and composting facility processing the organic fraction of MSW has been scaled up from 40,000 tons/year to 90,000 tons/year to increase production of renewable electricity and heat.	4/8/2015	No	Generation	$4,300,000	$4,300,000	$3,643,743	N/A	$3,643,743
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-045 Advanced Recycling to 1-MW Municipal Solid Waste of Electricity Generation	Applied Research and Development	This project designs, develops and tests a waste-to-energy Process Development Unit (PDU), involving conversion of Refuse Derived Biomass into clean fuel gas by Thermal-Catalytic Gasification, Reforming and Pulse Detonation Technology. This is a two-stage process, with a primary gasification stage, followed by a reforming stage; and hot filtration, followed by wet scrubbing of the process gas. This project tests a 3-pound per minute PDU, evaluates the results, and provides engineering data to design a 30 ton/day plant generating 1-MW electric power.	4/8/2015	No	Generation	$1,499,481	$1,499,481	$1,340,735	N/A	$1,340,735
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-046 Lowering Food-Waste Co-digestion Costs through an Innovative Combination of a Pre-Sorting Technique and a Strategy for Cake Solids Reduction	Technology Demonstration and Deployment	The project demonstrates two complementary approaches to lower the overall cost of co-digestion: a new technology to lower preprocessing cost of food wastes, and a new strategy to lower the mass of cake solids requiring disposal. The new technology for the preprocessing of food wastes uses an organic waste preprocessing technique known as an organic extrusion press (OEP) for selective extrusion of organic materials and is capable of recovering 95% of organics. The project applies a new strategy in operating co-digestion systems that involves optimizing the organic waste loading in a way that will lower the mass of cake solids requiring disposal relative to the conventional process.	4/8/2015	No	Generation	$1,496,902	$1,496,902	$592,872	N/A	$592,872

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-040 Self-Tracking Concentrator Photovoltaics for Distributed Generation	$282,545	$0	United States Department of Energy; U.S. Department of Energy;	$2,500,000	71.4%	Grant	Pre-existing intellectual property identified in agreement EPC-14-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Glint Photonics, Inc.	Group 4: Ranked # 2
EPC-14-041 Installation of a Lean Burn Biogas Engine with Emissions Control to Comply with Rule 1110.2 at a Wastewater Treatment Plant in South Coast Air Quality Management District	$0	$0	Anaergia Technologies, LLC;	$450,000	16.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Biogas & Electric, LLC	Group 3: Ranked # 5
EPC-14-044 Enabling Anaerobic Digestion Deployment for Municipal Solid Waste-to-Energy	$1,497,504	$0	Zero Waste Energy Development Company;	$1,500,000	25.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 6
EPC-14-045 Advanced Recycling to 1-MW Municipal Solid Waste of Electricity Generation	$188,248	$0	Taylor Energy;	$46,616	3.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Taylor Energy	Group 2: Ranked # 1
EPC-14-046 Lowering Food-Waste Co-digestion Costs through an Innovative Combination of a Pre-Sorting Technique and a Strategy for Cake Solids Reduction	$323,906	$0	Silicon Valley Clean Water (SVCW); Water Environment and Reuse Foundation;	$2,630,000	63.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Kennedy/Jenks Consultants	Group 3: Ranked # 4

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-040 Self-Tracking Concentrator Photovoltaics for Distributed Generation	N/A	N/A	Yes; Calif Based Entity	The project team estimates that 50% of rooftops would be appropriate for ST-CPV systems in California, where the average direct solar resource is 78% of the total solar resource. The successful development of this technology will bring significant manufacturing employment opportunities to California. Unlike conventional PV modules, ST-CPV modules are well-suited to local manufacturing because they do not benefit significantly from colocation with the semiconductor foundry. CPV cell technology is an area where US manufacturers have a substantial technical advantage over foreign competitors. An additional benefit conferred by this technology is an improved energy solution for remote off-grid communities. Many of such communities are located in desert areas of California that are particularly well-suited to the use of ST-CPV panels as a result of the high direct solar resource.	1a, 4a	Glint Photonics fabricated and tested three different prototypes (GEN 1-3) on the stationary-mount module design, in which prototypes Gen 3 integrates improvements on optics and internal tracking mechanism from Gen 1 and Gen 2. The improved prototype has been characterized in laboratory and outdoor testing, and the team has also conducted panel washing experiments to quantify the effect of soiling on panel efficiency. The tracked data displays better performance after the washing experiment. Results have shown that the module power efficiency presents a peak over 22% and the PV cell efficiency is around 32%. The optical efficiency meets the 55% target, with a peak of 70%, and the standard annual capture fraction is higher than 45 percent.
EPC-14-041 Installation of a Lean Burn Biogas Engine with Emissions Control to Comply with Rule 1110.2 at a Wastewater Treatment Plant in South Coast Air Quality Management District	N/A	N/A	Yes; Calif Based Entity	The technology that was to be demonstrated was a low cost NOx and SOx reduction wet scrubbing technology called NOxRx (a registered trademark) which can be used in conjunction with all biogas engines and anaerobic digesters in the market today. NOxRx has a patented method of utilizing the effluent stream from an anaerobic digester to reduce emissions from biogas engines. Unlike SCR, it does not produce N2O and does not require H2S removal or biogas conditioning prior to combustion. Therefore, NOxRx represents a significant cost savings over competing NOx reduction solutions. The goal of this project was to demonstrate the commercial viability of NOxRx for biogas-fired lean burn engines to comply with CARB NOx and SOx standards, and SCAQMD Rule 1110.2.	1a, 1c, 1f, 3a, 3b, 4b, 4e	Biogas and Electric was unable to demonstrate its emission reduction system at the Palm Springs and the project termed-out.
EPC-14-044 Enabling Anaerobic Digestion Deployment for Municipal Solid Waste-to-Energy	N/A	N/A	Yes; Calif Based Entity	This project provides valuable insight to identify optimum pathways that overcome barriers for large-scale deployment of biomass conversion technologies. The research has focused on overcoming barriers for urban stakeholders, including odor, access to the utility grid, and improved utilization of waste heat.	2a, 3g, 4a	Researchers measured NOx emissions during several flaring events to establish primary NOx formation pathways, which may include thermal, fuel, and prompt NOx formation. The team performed air emission measurements and modeling to minimize odors and greenhouse gases from anaerobic digestion and the composting facility. Researchers have updated the Life Cycle Assessment model to identify opportunities for improved economic and environmental performance by quantifying the life-cycle cost, energy demand, and the GHG impacts of the existing ZWEDC facility and paths to scale-up. ZWEDC has interconnected to PG&E grid and enrolled in CAISO to enable sale of net electricity.
EPC-14-045 Advanced Recycling to 1-MW Municipal Solid Waste of Electricity Generation	N/A	N/A	Yes; Calif Based Entity	The project researches, develops, and verifies thermal catalytic gasification technology that will overcome technical and economic barriers preventing the use of refuse derived biomass (RDB) as an energy resource in California. Completion of the current gasification/reforming test program enables future scale-up to 30-ton/day RDB-to-energy (1-MWe scale), in preparation for commercial scale design at 300-ton/day, generating 10-MW of electricity with costs of less than $3,750/kWh of installed capacity.	2a, 4a, 4e	Design and fabrication of the Process Development Unit and equipment layout work at the host site is complete. Major equipment, consisting of PDU, Reformer, gas-flare and gas conditioning equipment was installed. Testing of the gasification system has started. One TAC meeting and two CPR meetings were held to review project progress towards achieving goals and objectives. Initial startup of the gasification was performed using 8 lbs. of wood pellets, and then refuse derived biomass. The pulse burner operated at 900 degrees C and produced 9.47% char by weight. Startup testing is complete. The rate of char conversion was increased by a modification to the gasifier that allows char particles to stay longer in the gasification zone. This modification also resulted in increased syngas production.
EPC-14-046 Lowering Food-Waste Co-digestion Costs through an Innovative Combination of a Pre-Sorting Technique and a Strategy for Cake Solids Reduction	N/A	N/A	Yes; Calif Based Entity	This project will result in reliable and cost-effective bioenergy from wastewater treatment plants (WWTP) through the integration of an organic waste preprocessing technique known as organic extrusion press and co-digestion of locally available food waste and restaurant fats, oil, and grease (FOG) in an optimized manner that lowers the mass of cake solids that needs disposal. Though there is some seasonal variation, the supply of wastewater, food waste and FOG are very reliable.	3a, 4a, 4e	The research team completed benchmarking of digester performance for operations without the addition of food waste and Fats, Oils and Grease (FOG) at two sludge loading conditions. Digester tests were completed through addition of FOG to the digesters at three loading conditions. To facilitate the FOG testing, a FOG preprocessing unit was installed and operated. Installation of the Organics Extrusion Press (OREX) for extraction of food waste is completed, along with the initial characterization of the extruded food waste. A food waste receiving station and a polishing unit for OREX extracted food waste is installed and trial tested. Tests using polished food wastes are expected be completed in January 2019. Results from the study were presented at WEF Residuals and Biosolids Conference in April 2017 and CWEA annual conference in April 2018.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-047 Dairy Waste-to-Bioenergy via the Integration of Concentrating Solar Power and a High Temperature Conversion Process	Applied Research and Development	The goal of the project is to integrate Concentrating Solar Power (CSP) and Hydrothermal Processing (HTP) into a single, integrated system; confirm that it can convert dairy manure into RNG and bio-crude; study the economics of integrated CSP-HTP systems sited at dairy farms; and confirm that the RNG produced meets pipeline-transmission and geological-storage quality standards. In this way, the project anticipates proving that it is possible to store the energy contained in dairy manure waste in a manner that enables California natural gas plants to produce readily dispatchable, ultra-low-emissions renewable electricity.	4/8/2015	No	Generation	$1,494,736	$1,494,736	$851,946	N/A	$851,946
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-050 City of Fremont Fire Stations Microgrid Project	Technology Demonstration and Deployment	The project team designed and built microgrids at three fire stations in Fremont, California. Each microgrid consists of a microgrid energy management system, a parking lot canopy photovoltaic system, and a battery energy storage system. The automated microgrid control system manages local energy resources and loads. The microgrids are designed to provide at least three hours a day of power for critical loads during a utility power outage.	4/8/2015	No	Distribution	$1,817,925	$1,817,925	$1,645,995	N/A	$1,645,995
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	Applied Research and Development	This project aims to design, deploy, and test a 150 kilowatt-electric (kWe) modular, mobile biomass gasification generator (the Powertainer) that converts forest slash biomass into on demand renewable energy and meets the California Air Emission Standards. The results of the demonstration will be analyzed to determine (1) optimal siting to enhance grid stability, (2) impact of monetizing current forest waste as fuel on ability to increase forest thinning and lower wildfire risk, and (3) impact of increased thinning on availability of hydrological resources.	4/8/2015	No	Generation	$1,990,071	$1,990,071	$1,563,059	N/A	$1,563,059
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	Applied Research and Development	This project aims to design, deploy, and test a 150 kilowatt-electric (kWe) modular, mobile biomass gasification generator (the Powertainer) that converts forest slash biomass into on demand renewable energy and meets the California Air Emission Standards. The results of the demonstration will be analyzed to determine (1) optimal siting to enhance grid stability, (2) impact of monetizing current forest waste as fuel on ability to increase forest thinning and lower wildfire risk, and (3) impact of increased thinning on availability of hydrological resources.	4/8/2015	No	Generation	-$99,946	-$99,946	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-052 Community Scale Digester with Advanced Interconnection to the Electrical Grid	Technology Demonstration and Deployment	The project's aim is to install and operate an innovative anaerobic digestion system using a high-rate biodigester technology that will process approximately 50 tons per day (TPD) of organic waste from a large supermarket (Albertsons) distribution center and 50 TPD (20,000 gallons) of high-strength slurry created by recovering and concentrating organics in wastewater streams. This project is co-located with the Co-West Commodities Wastewater Pre-Treatment Facility- an operation that collects wastewater (carbs, sugar, protein, and fat, grease, and oil known as FOG) from industrial businesses and pre-treats the material for disposal into the local sewer system.	4/8/2015	No	Generation	$5,000,000	$5,000,000	$3,459,038	N/A	$3,459,038

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-047 Dairy Waste-to-Bioenergy via the Integration of Concentrating Solar Power and a High Temperature Conversion Process	$98,501	$0	Southern California Gas Company (SoCalGas);	$600,000	28.6%	Grant	Pre-existing intellectual property identified in agreement EPC-14-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Southern California Gas Company (SoCalGas)	Group 2: Ranked # 2
EPC-14-050 City of Fremont Fire Stations Microgrid Project	$73,475	$0	City of Fremont; Gridscape Solutions, Inc.; Delta Products Corporation; Microgrid Energy;	$657,260	26.6%	Grant	Pre-existing intellectual property identified in agreement EPC-14-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Gridscape Solutions, Inc.	Group 1: Ranked # 2
EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	$311,727	$0	All Power Labs, Inc.;	$686,038	26.6%	Grant	Pre-existing intellectual property identified in agreement EPC-14-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	All Power Labs, Inc.	Group 1: Ranked # 3
EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	$0	$0	All Power Labs, Inc.;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	All Power Labs, Inc.	Group 1: Ranked # 3
EPC-14-052 Community Scale Digester with Advanced Interconnection to the Electrical Grid	$252,977	$0	CleanWorld; Organic Energy Solutions;	$7,772,939	60.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Organic Energy Solutions	Group 3: Ranked # 3

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-047 Dairy Waste-to-Bioenergy via the Integration of Concentrating Solar Power and a High Temperature Conversion Process	N/A	N/A	None	This project will develop and demonstrate a new bioenergy pathway which utilizes hydrothermal processing and concentrating solar power to convert dairy manure into bio-crude and renewable natural gas that will enable dispatchable and low emissions renewable electricity.	1a, 1i, 2a, 3g, 4a, 4b, 4e	Redesign of the CSP receiver was completed by NREL in early 2016, and fabrication of the receiver was completed in 2017. Design of the Genifuel hydrothermal processing (HTP) unit with input from the Pacific Northwest National Laboratories (PNNL) was completed in late 2016 and a fabricator was chosen in early 2017. Construction of the HTP system is complete and the Hyperlight CSP facility has been expanded to a half acre in size using redesigned collectors and receivers. The HTP system has been commissioned and testing is taking place after integration with the Hyperlight system.
EPC-14-050 City of Fremont Fire Stations Microgrid Project	N/A	N/A	Yes; Calif Based Entity, Minority Owned	Critical facilities, such as fire stations, are vulnerable to power outages, so having local, renewable generation decreases their dependence on outside electricity sources. This is the first implementation of microgrids for several fire stations in the region and creates a great opportunity for proof of concept to overcome risk and knowledge barriers to adopting high penetration solar PV systems and energy storage, demonstrate energy efficiency by optimizing power generation and loads, and provide increased energy security during utility power outages. The microgrids will help reduce grid congestion and increase grid reliability.	1e, 1h, 4a, 5a	Gridscape Solutions has successfully completed design, procurement, construction, and commissioning of the microgrids at all three fire stations. The microgrid at Fire Station #11 has been operational since September 2017, while the other two microgrids have been operational since October 2018. The second two microgrids were held up by delays in addressing liquefaction issues at the sites and obtaining interconnection agreements. Data collection for all three microgrids is in progress. Gridscape has also presented this project at several conferences such as Silicon Valley Energy Summit and VERGE Microgrid Summit. It is expected to commercialize this technology by the end of the agreement in early 2019.
EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	N/A	N/A	Yes; Calif Based Entity	This project develops and demonstrates a higher capacity, mobile conversion system capable of cost-effectively converting forest biomass near where it is sourced into renewable, on-demand energy to help address a myriad of issues associated with climate change, including drought, fires, and the need for more renewable energy.	1a, 1c, 4a	The project team concluded activities related to the Engineering Validation Testing (EVT) and Design Validation Testing (DVT) to prepare the system to perform a 40-hour engine test on fully assembled system. In the EVT, the project team tested the minimum uptime capacity to determine whether or not the gasifier meets the desired minimum uptime capacity for the Powertainer. The target was to power the generator set at 75kW for 8 hours continuously and the gasifier was able to demonstrate its ability to support operations for extended run time. The team also conducted a test to determine the amount of tar present in the producer gas. The tar content of the gas post-gasifier and post-filter shall not exceed 1500 mg/m3 and 1000 mg/m3, respectively. Although the criteria were met, numbers might improve once the reactor is at the correct operating temperature with a proper load on the system.
EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	N/A	N/A	Yes; Calif Based Entity	This project develops and demonstrates a higher capacity, mobile conversion system capable of cost-effectively converting forest biomass near where it is sourced into renewable, on-demand energy to help address a myriad of issues associated with climate change, including drought, fires, and the need for more renewable energy.	1a, 1c, 4a	The project team concluded activities related to the Engineering Validation Testing (EVT) and Design Validation Testing (DVT) to prepare the system to perform a 40-hour engine test on fully assembled system. In the EVT, the project team tested the minimum uptime capacity to determine whether or not the gasifier meets the desired minimum uptime capacity for the Powertainer. The target was to power the generator set at 75kW for 8 hours continuously and the gasifier was able to demonstrate its ability to support operations for extended run time. The team also conducted a test to determine the amount of tar present in the producer gas. The tar content of the gas post-gasifier and post-filter shall not exceed 1500 mg/m3 and 1000 mg/m3, respectively. Although the criteria were met, numbers might improve once the reactor is at the correct operating temperature with a proper load on the system.
EPC-14-052 Community Scale Digester with Advanced Interconnection to the Electrical Grid	N/A	N/A	Yes; Calif Based Entity	The project will demonstrate the use of electrical generation powered by digester gas to provide reliable power to a critical facility during outages on the grid. The electricity from this project will be exported to the SoCal Edison distribution grid through SB 1122 Bioenergy Feed-in Tariff. The system will also be equipped with islanding capability to support the critical facility during an interruption in the grid.	1b, 1c, 2a	The project team has completed the design phase and purchased equipment for the demonstration which is currently being stored off-site. However, because the project experienced delays in interconnection and permitting processes, the grantee will not be able to complete the installation and testing within the term of the agreement. A stop work order was issued in December 2018 pending Energy Commission determination as to how to proceed.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-053 A Renewable Based Direct Current Building Scale Microgrid	Technology Demonstration and Deployment	The team developed a DC microgrid that connects on-site generation directly with loads and provides a low cost, energy-efficient solution for warehouse facilities. Solar PV is directly connected to energy-efficient DC lighting, a DC energy storage system, and ventilation to form a DC building microgrid. This microgrid system reduces the need for inverters for PV and rectification equipment for the loads and is operated by a Bosch microgrid controller system. The microgrid improves the overall utilization of solar energy by roughly 7-10% as compared to conventional AC systems, while lowering component complexity and costs.	4/8/2015	No	Distribution	$2,817,566	$2,817,566	$1,917,138	N/A	$1,917,138
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-054 Demonstrating a renewable based microgrid for a critical facility at the Blue Lake Rancheria	Technology Demonstration and Deployment	This project team developed and demonstrated a microgrid at an American Red Cross evacuation center. The microgrid included renewables and energy storage to bolster the resiliency of this critical support facility and the capability of the microgrid to power itself with a high penetration of local renewable resources.	6/10/2015	No	Distribution	$5,000,000	$5,000,000	$5,000,000	N/A	$5,000,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-055 Las Positas Community College Microgrid	Technology Demonstration and Deployment	This project is demonstrating the ability of a commercial-scale microgrid to optimize distributed energy resources for a campus, and distribution utilities by using advanced energy management tools to coordinate a high penetration of renewable energy assets with energy storage technologies on a community college microgrid.	4/8/2015	No	Distribution	$1,522,591	$1,522,591	$883,725	N/A	$883,725
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-056 Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid	Technology Demonstration and Deployment	This project installed PEV charging equipment in five sites in Santa Monica to demonstrate scenarios that represented new power needs, including smart charging, peak shaving, load management, and load smoothing while improving power quality and grid stability. The selected sites reflected a variety of scenarios including public charging, fleet charging, integration of solar generation with charging, and integration of energy storage with fast charging. Further, the project assessed the usefulness of vehicle to grid and vehicle to building technologies for allowing bi-directional energy flow and using PEVs as distributed energy storage. The project objective was to provide a model (using simulations to predict grid behavior and emulations using real-world power flows) that could be used by fleet owners or building owners for grid planning, pricing, and incentive decisions.	4/8/2015	No	Demand-side Management	$1,989,432	$1,989,432	$1,657,751	N/A	$1,657,751

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-053 A Renewable Based Direct Current Building Scale Microgrid	$276,825	$0	Maxwell Technologies; AMERICAN HONDA MOTOR COMPANY, INC.; Robert Bosch LLC; Regents of the University of California, Davis - California Lighting Technology Center; Imergy Power Systems;	$1,797,544	38.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Robert Bosch LLC	Group 2: Ranked # 1
EPC-14-054 Demonstrating a renewable based microgrid for a critical facility at the Blue Lake Rancheria	$832,908	$0	Humboldt State University Foundation, Schatz Energy Research Center; Pacific Gas and Electric Company; Siemens Energy and Automation, Inc.; Tesla, Inc.; Serraga Energy, LLC at Blue Lake Rancheria; GHD, Inc.;	$1,318,422	20.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Humboldt State University Sponsored Programs Foundation	Group 1: Ranked # 1
EPC-14-055 Las Positas Community College Microgrid	$260,719	$0	Chabot-Las Positas Community College District;	$450,000	22.8%	Grant	Pre-existing intellectual property identified in agreement EPC-14-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Chabot-Las Positas Community College District	Group 2: Ranked # 3
EPC-14-056 Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid	$358,770	$500,000	City of Santa Monica; The Regents of the University of California, Los Angeles; Korea Institute of Energy Research (KIER); California Lithium Battery; Proximetry;	$500,000	20.1%	Grant	Pre-existing intellectual property identified in agreement EPC-14-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Regents of the University of California, Los Angeles	Group 3: Ranked # 3

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-053 A Renewable Based Direct Current Building Scale Microgrid	N/A	N/A	Yes; Calif Based Entity	This project will demonstrate the feasibility and benefits of a commercial-scale DC building microgrid that uses multiple DC technologies to provide reliable power to the loads on DC circuits, resilience during grid outages, increased energy efficiency and renewable energy utilization with lower losses.	1e, 1h, 4a, 5a, 5d	No outstanding issue other than Bosch getting out of microgrid business. CAM working on final report with PI.
EPC-14-054 Demonstrating a renewable based microgrid for a critical facility at the Blue Lake Rancheria	N/A	N/A	Yes; Calif Based Entity	The project advanced microgrid technology by demonstrating a new microgrid controller and integrating a set of equipment that had not previously been combined in a microgrid setting. The project demonstrated the ability to integrate solar electric power with battery energy storage, conventional generators, and dispatchable demand into a microgrid to support a certified American Red Cross shelter, with an added benefit of relegating the existing fossil fueled generators to a deep backup role where they rarely run. A microgrid control system was successfully implemented using protection relays to provide safe and reliable microgrid operation. It was able to perform automated transitions from grid connected to islanded states in response to the state of the area electric power system.	1e, 1h, 4a, 5a, 5d	The project was completed in March 2018. The Blue Lake Rancheria renewable microgrid has demonstrated a robust, renewable-based microgrid system that provides costs savings for the facility during normal operation and successfully islanded during a grid outage. As a result of knowledge transfer and outreach activities, the microgrid project received the Federal Emergency Management Agency's 2017 Whole Community Preparedness Award and POWERGRID International's Project of the Year (2018) award for Distributed Energy Resource Integration, marking the first time that a non-utility won the award. The final report is available at: https://www.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf.
EPC-14-055 Las Positas Community College Microgrid	N/A	N/A	Yes; Calif Based Entity	The project identifies and measures the benefits of microgrids for customers that shift peak energy use to coincide with peak solar production and for distribution utilities by demonstrating the resource capability of microgrids. This project will measure the microgrid's benefits by using existing retail rates as well as simulating a market in which all microgrid benefits can be monetized.	1e, 1h, 4a, 5a, 5d	The project team completed installation of the system and commissioning of the microgrid and has begun measurement and verification of the energy efficiency elements of the project. An additional master control system was installed to coordinate the demand charge management software and the islanding transfers. PG&E approved the system to operate. The team presented at the February 2018 California K-12 Facilities conference and the April 2018 PG&E Microgrid Workshop for Campus Facility Directors.
EPC-14-056 Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid	N/A	N/A	Yes; Calif Based Entity	Most current electric vehicle service equipment (EVSE) provide uncontrolled charging without using smart algorithms, software, or standard network technologies. This project demonstrated a pre-commercial PEV infrastructure that used a control center, communicating over a wireless communication network, to control the charging operations of the EVSEs using smart charging algorithms. The pre-commercial infrastructure (WINSmartEV TM) developed by UCLA was advanced so that it is able to determine optimized charging and/or vehicle to grid services based on PEV profiles, user preferences, grid-related events, and grid capacities.	1h, 3f, 4b	The final report was published in August 2018: http://www.energy.ca.gov/2018publications/CEC-500-2018-020/CEC-500-2018-020.pdf. The research demonstrated that large numbers of PEVs can be managed for the benefit of the PEV and facility owners. The recipient successfully developed a system, utilizing existing charging infrastructure and without adding large amounts of power capacity, that could control and balance charging through scheduling algorithms that met the needs of the PEV and facility owners. The recipient also demonstrated how the system can be used by facility (e.g., garage) owners to save money through demand charge reduction and demand response, while supporting their employees or customers.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-057 Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets	Technology Demonstration and Deployment	This project developed and demonstrated a managed charging system applied to more than 25 Alameda County fleet electric vehicles and charging stations. The researchers also developed approaches to engage non-fleet electric vehicle owners who charge their vehicles at Alameda County's publicly available charging stations and managed their charging station loads to further reduce utility costs. Although the project focused on one-way (uni-directional) charging, the approach is compatible with future vehicles and chargers that may have two-way (bi-directional) charging capability. The research had three main technical tasks: Task 1 - Characterize site and fleet, collect charging session and meter data, and analyze data for control strategies; Task 2 - Implement and demonstrate fleet and public electric vehicles managed charging control system; Task 3 - Quantify the potential of fleet and non-fleet electric vehicles in the managed charging system as demand response capabilities in the retail and wholesale electricity markets.	4/8/2015	No	Demand-side Management	$1,993,355	$1,993,355	$1,794,690	N/A	$1,794,690
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-059 Laguna Subregional Wastewater Treatment Plant Microgrid	Technology Demonstration and Deployment	This project is upgrading a wastewater treatment plant to use a microgrid with a solar photovoltaic system, energy storage, and a microgrid controller for increased resiliency and greater use of renewable energy.	4/8/2015	No	Distribution	$4,999,804	$4,999,804	$2,584,459	N/A	$2,584,459
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-060 Demonstrate a utility-owned renewable based community microgrid at Borrego Springs California	Technology Demonstration and Deployment	SDG&E and the project team demonstrated a utility-owned renewable based community microgrid at Borrego Springs California. The renewable based microgrid is able to island the entire community with a peak load of approximately 14 MW, serving approximately 2,500 residential and 300 commercial and industrial customers. The SDG&E microgrid utilizes a 26 MW PV system, two substation batteries, three distributed batteries and an ultracapacitor.	4/8/2015	No	Distribution	$4,724,802	$4,724,802	$3,882,476	N/A	$3,882,476
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-061 Learning from Real-World Experience to Understand Renewable Energy Impacts to Wildlife	Applied Research and Development	This research uses real-world data to understand renewable energy impacts to wildlife. The approach is to analyze observed wildlife fatalities and habitat loss to determine the significance of fatalities to population persistence; compare pre-construction predicted and post-construction actual impacts (fatalities) to sensitive species, as a foundation for improving predictive accuracy; and compare predicted and actual benefits of mitigation to sensitive species, as a foundation for improving predictive accuracy. The research goal is to produce a set of decision-making tools for renewable energy developers and permitting and regulatory agencies in California.	6/10/2015	No	Generation	$1,000,000	$1,000,000	$223,108	N/A	$223,108
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-062 Energy Efficiency in California's Water Sector Using Customized Energy Management and Supervisory Control and Data Acquisition Systems	Technology Demonstration and Deployment	This project involves setting up links using software and hardware at pumping stations for water delivery, storage or treatment that enable the integration and transmission of data from energy meters directly or indirectly into Supervisory Control and Data Acquisition (SCADA) systems that are traditionally set up to monitor water quality parameters in real time. Combined with historical energy use data on the platform operators can manage systems in real time to monitor and control peak demand.	5/13/2015	No	Demand-side Management	$3,017,034	$3,017,034	$967,406	N/A	$967,406

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-057 Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets	$812,829	$0	Bay Area Climate Collaborative; The Regents of the University of California, Berkeley; Kisensum; ChargePoint, Inc.; County of Alameda, General Services Agency;	$536,761	21.2%	Grant	Pre-existing intellectual property identified in agreement EPC-14-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 2
EPC-14-059 Laguna Subregional Wastewater Treatment Plant Microgrid	$187,080	$0	City of Santa Rosa; Parker Hannifin Corp; Nuvation Engineering;	$2,290,000	31.4%	Grant	Pre-existing intellectual property identified in agreement EPC-14-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Trane U.S., Inc.	Group 1: Ranked # 3
EPC-14-060 Demonstrate a utility-owned renewable based community microgrid at Borrego Springs California	$923,165	$0	San Diego Gas and Electric Company; SMA America; OSISoft, LLC;	$1,739,560	26.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	San Diego Gas & Electric Company	Group 2: Ranked # 4
EPC-14-061 Learning from Real-World Experience to Understand Renewable Energy Impacts to Wildlife	$262,924	$0	US Geological Survey; University of Maryland Center for Environmental Studies Appalachian Laboratory; NextEra Energy;	$1,617,177	61.8%	Grant	Pre-existing intellectual property identified in agreement EPC-14-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	U.S. Geological Survey (Forest and Rangeland Ecosystem Science Center - FRESC)	Group 2: Ranked # 1
EPC-14-062 Energy Efficiency in California's Water Sector Using Customized Energy Management and Supervisory Control and Data Acquisition Systems	$452,544	$0	Inland Empire Utilities; OSISoft, LLC; Regents of the University of California, Riverside Campus; Opto 22; Cucamonga Valley Water District; Olivehain Municipal Water District;	$1,722,732	36.3%	Grant	Pre-existing intellectual property identified in agreement EPC-14-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	University of California, Riverside	Ranked # 6

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-057 Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets	N/A	N/A	Yes; Calif Based Entity	This project developed an aggregation system for smart charging PEV vehicles to provide demand response, mitigate demand charges, and leverage time of use rates. A charging control system was applied to a fleet of vehicles owned by Alameda County and to charging stations that are used by both county vehicles and the public. The project added systems for intelligent prediction of PEV loads and control algorithms to create a flexible, modular, and scalable solution for smart charging county fleet and public PEVs. The managed charging control system will enable growth in PEV adoption without straining current grid infrastructure. These approaches can also be applied to commercial and workplace charging and provide large benefits in managing peak electricity demand across California by helping consumers reduce or shift their electricity use during times when electricity demand is high.	1g, 1h, 2a, 3f, 4a, 4b, 5b	The project successfully demonstrated a set of smart charging strategies at an Alameda County parking garage. Highlights include development of separate smart charging system platforms to meet the different requirements of each application (i.e., fleet vehicles, public vehicles, and the direct current fast charger); recruitment of public charging users to participate; public PEV managed charging to achieve utility bill savings by managing peak demand; and quantification of the potential of the fleet PEV managed charging system for multiple demand response products in California electricity markets. As a result of this project, LBNL was able to further build out the MyFleetBuy tool to help fleet owners incorporate PEVs into their fleet. LBNL is working with Alameda, Oakland, and Caltrans to help facilitate PEV smart charging technologies into their large-scale fleet procurement processes.
EPC-14-059 Laguna Subregional Wastewater Treatment Plant Microgrid	N/A	N/A	Yes; Calif Based Entity	This project will demonstrate that a microgrid at a wastewater treatment plant can operate without compromising water quality or negatively affecting plant operations. The EPIC funds greatly accelerate the commercialization timeline by demonstrating a functional microgrid that addresses challenges with integrating energy storage, on-site generation, and control components to improve resilience.	1e, 1h, 4a, 5a, 5d	The microgrid is finishing construction and all equipment is in place. The project team successfully received all permits from the city of Santa Rosa, which were delayed substantially because of the volume of permits being reviewed by the city after the wildfires. Completion of those permits has allowed the team to perform construction activities. Permit applications are in process for the Air Quality Management District and the PG&E interconnection. Once all permits are received the microgrid will be commissioned, and operational data will be collected.
EPC-14-060 Demonstrate a utility-owned renewable based community microgrid at Borrego Springs California	N/A	N/A	Yes; Calif Based Entity	The project demonstrated improved grid resiliency from using a high penetration renewable based microgrid. There was an immediate benefit to the Borrego Springs community of non-interrupted energy resources during power outages. The microgrid controller was also able to make greater use of the large local solar plant's renewable energy while avoiding adverse grid impacts by coordinating the operation of the various energy storage units with the solar energy output.	1e, 1h, 4a, 5a, 5d	The project was completed in July 2018. The Borrego Springs Microgrid project demonstrated a robust, renewable-based system that provides critical power during emergencies and planned outages, which are necessary when system upgrades and maintenance work are needed. Unlike behind the meter microgrids, the Borrego Springs Microgrid is the first true community microgrid for an entire city and not just for a single metered customer. A unique aspect of this microgrid is that the microgrid assets are located throughout the community where they are able to provide the greatest support. The final report is available at: https://www.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf.
EPC-14-061 Learning from Real-World Experience to Understand Renewable Energy Impacts to Wildlife	N/A	N/A	Yes; Calif Based Entity	This project is developing and applying a unique combination of stable isotope analysis and demographic modeling to characterize wildlife populations of interest affected by fatalities at renewable energy facilities in California. The project is also developing a novel application of techniques that evaluates statistical models to improve forecasting of wildlife fatality rates and mitigation outcomes. The approach will be high-tech, scientifically innovative, and ultimately subject to peer-review via publication in scientific journals. Implementation of this set of tools will benefit ratepayers by streamlining permitting and reducing costs of energy development and electricity.	2a, 3a, 4f, 4g	As of fall 2018, the project is transitioning from data analysis to the writing phase. The research team has compiled more than 600 environmental reports to review pre- and post-construction surveys at renewable energy facilities. About 3,000 samples have been prepared for isotopic analysis to determine the geographic origin of individuals. Together with experts, the research team developed a list of 34 species of five types on which to focus. Each type is being modeled with the most appropriate kind of demographic model using data from other parts of the project to estimate the effect of mortality at renewable energy facilities. The team has also shared sample material from carcasses found at renewable energy facilities with the team from EPC-15-043 to increase their database for genetic analyses. The study has already published two journal articles, with several more underway.
EPC-14-062 Energy Efficiency in California's Water Sector Using Customized Energy Management and Supervisory Control and Data Acquisition Systems	N/A	N/A	Yes; Calif Based Entity	This project will highlight a pathway for water and wastewater agencies in California to increase energy efficiency and reduce their peak energy consumption with no decrement in service or reliability by monitoring real time energy consumption. This project provides equipment energy data to the water district operators, who can make decisions on optimal equipment operation. Ultimately, better pump and other equipment management will reduce energy costs; especially during peak demand periods when energy costs are most expensive.	1e, 1h, 4a	The research team continues to monitor the energy system data from all three water districts while also discussing potential for additional demand reduction based on data collected and trends. As the project approaches the end of the agreement term, the research team will be finalizing the last stages of technology transfer and independent verification and validation. The individual water districts will be interfacing the Energy Management System with their existing operation and SCADA network. A public workshop is planned in early 2019 to communicate their findings to the public.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-063 Advance Wastewater Treatment Using Forward Osmosis to Produce High Quality Water	Technology Demonstration and Deployment	This project demonstrates an advanced wastewater treatment technology, the PFO Recycler, that produces high quality water while reducing energy, chemicals and maintenance required for treatment of industrial wastewaters. The PFO Recycler uses forward osmosis to extract the water from the waste stream and reverse osmosis to extract the water out of the forward osmosis draw solution. If the project is successful then this technology could be used to treat challenging wastewaters to achieve high purity and provide high temperature water for reuse while using less energy than other processes. Reclaiming water for onsite reuse will reduce the need for fresh water purchases.	5/13/2015	No	Demand-side Management	$3,230,420	$3,230,420	$2,145,462	N/A	$2,145,462
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-064 Aerosol Impacts on the Hydrology and Hydropower Generation in California	Applied Research and Development	The research team enhanced and used a fully coupled aerosol-meteorology-snowpack forecast model for hydropower applications, using observational datasets (precipitation, snowpack, stream inflow) for Southern California Edison's hydropower plant on Big Creek. The main goal was to estimate the impacts of aerosols on hydropower generation and explore the use of improved forecasts to improve the management of hydropower units.	5/13/2015	No	Generation	$399,818	$399,818	$275,680	N/A	$275,680
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-065 Demonstration of Forward Osmosis to Produce Juice Concentrate, Purify and Reuse Wastewater and Reduce Energy Use	Technology Demonstration and Deployment	This project is demonstrating a new technology innovation, the PFO Concentrator, to reduce the energy, chemicals, and maintenance required for food and beverage processing and waste concentration. The PFO concentrator dewaters fruits and vegetables for production of food and beverage concentrates and purees and could replace energy intensive thermal evaporators. Additionally, water is extracted from the concentrated product for reuse on-site.	5/13/2015	No	Demand-side Management	$2,499,289	$2,499,289	$1,944,097	N/A	$1,944,097
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-066 High-Performance Integrated Window and Facade Solutions for California Buildings	Applied Research and Development	This project develops, validates and quantifies energy impacts of a new generation of high performance building envelope systems such as highly insulating windows, novel window-integrated local ventilation, and dynamic daylight-redirection. It will provide design and management toolkits that will enable the building industry to meet challenging energy performance goals leading to zero net energy buildings. This project considers cost-effective integrated system approaches to reduce energy use associated with HVAC and lighting while improving occupant comfort.	5/13/2015	No	Demand-side Management	$3,000,000	$3,000,000	$3,000,000	N/A	$3,000,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-067 Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems	Applied Research and Development	The project will advance hydrologic modeling and improve the Precipitation-Runoff Modeling System (PRMS) used by PG&E allowing for more effective management of hydropower resources. The goals will be achieved using innovative smart wireless sensor network made up of small sensor stations mounted on poles linked by low-power radio, which produces real-time hydrologic data. These data, blended with satellite and Light Detection And Ranging (LiDAR) remote sensing data, have the potential to greatly improve hydrologic forecasting for the Sierra Nevada and other areas in California.	5/13/2015	No	Generation	$1,100,000	$1,100,000	$248,903	N/A	$248,903

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-063 Advance Wastewater Treatment Using Forward Osmosis to Produce High Quality Water	$964,131	$0	Porifera, Inc.; Lawrence Berkeley National Laboratory; TBD - General Contractor;	$646,493	16.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Porifera, Inc.	Ranked # 2
EPC-14-064 Aerosol Impacts on the Hydrology and Hydropower Generation in California	$92,951	$0	University of California, Riverside; University of California Los Angeles;	$306,237	43.4%	Grant	Pre-existing intellectual property identified in agreement EPC-14-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Regents of the University of California, Riverside Campus	Group 3: Ranked # 2
EPC-14-065 Demonstration of Forward Osmosis to Produce Juice Concentrate, Purify and Reuse Wastewater and Reduce Energy Use	$621,536	$0	Porifera, Inc.; CDM Smith, Inc. ; Los Gatos Tomato;	$628,568	20.1%	Grant	Pre-existing intellectual property identified in agreement EPC-14-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Porifera, Inc.	Ranked # 7
EPC-14-066 High-Performance Integrated Window and Facade Solutions for California Buildings	$1,308,746	$450,000	United States Department of Energy;	$450,000	13.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-066 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 10
EPC-14-067 Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems	$205,897	$0	California Department of Water Resources; University of California Merced;	$236,263	17.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	The Regents of the University of California, Berkeley	Group 3: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-063 Advance Wastewater Treatment Using Forward Osmosis to Produce High Quality Water	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	The project includes technological advancements in membrane development and module design in forward osmosis to address cost and performance issues. The demonstration projects are located at a winery, frozen food facility and a soap company. Each demonstration is documenting energy savings and potential for this technology to purify, concentrate and reuse challenging wastewaters that contains high levels of contaminants. This technology has the potential for application in the food and beverage, oil and gas, and other industrial sectors.	1f, 1h, 4a, 4c	Porifera has finished collecting the data from the Jackson Family Wines project site and is analyzing the data. Recipient is collecting data from the Ale Industries site and initiating work on the Dr. Bronner's site demonstration.
EPC-14-064 Aerosol Impacts on the Hydrology and Hydropower Generation in California	N/A	N/A	Yes; Calif Based Entity	The proposed research is intended to significantly advance our knowledge of aerosol impacts on the hydrology and hydropower generation in California. The results of this project are expected to improve the management of hydropower units which should reduce overall electricity generation costs and assist with adaptation under a changing climate.	1c, 4a, 5c	The research team successfully ran a chemistry-aerosol-meteorological model and coupled this model with a model used by Southern California Edison (SCE) to operate their Big Creek Hydroelectric System. The modeling results suggest that aerosols induce a reduction of annual inflows on the order of 4% to 14% but that the reductions are more significant in the summer. The research team calculated the loss of generation and revenue and found that aerosols reduce hydropower generation by about 6%, which is equivalent to an annual loss of about $3 million a year. The final report was submitted and will be posted in the near future. The researchers have shared results with others via scientific conferences and journal publications. SCE was heavily involved with the research team during the execution of the project and co-authored a conference paper with the research team.
EPC-14-065 Demonstration of Forward Osmosis to Produce Juice Concentrate, Purify and Reuse Wastewater and Reduce Energy Use	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	The technology uses forward osmosis and reverse osmosis in an energy efficient way to achieve the equipment performance of an evaporator and, in addition, generates purified water streams for reuse. This technology could lower energy use and costs for food processing and industrial operations through replacement of energy intensive thermal evaporators and reuse of wastewater streams onsite, rather than disposed through the municipal system.	1f, 1h, 4a, 4c	Porifera is working on regulatory approval for food contact with the PFO Concentrator at Los Gatos Tomato and has begun testing and data collection at the facility. Testing at the Anheuser-Busch site continues and data collection is underway. Testing the PFO Concentrator at Jackson Family Wines is complete, and product quality and data are being analyzed.
EPC-14-066 High-Performance Integrated Window and Facade Solutions for California Buildings	N/A	N/A	Yes; Calif Based Entity	Almost all building envelope products offered on the market today address a narrow, component-oriented set of performance goals often set by prescriptive codes, e.g. a U-value, with only a limited consideration of the broader tradeoffs possible in the context of whole-building performance. This project uses an integrated systems approach that aims to improve the performance and cost of highly insulating (Hi-R) windows, window-integrated ventilation systems, and dynamic daylight redirecting systems. Supporting tools, data, and design methods are also being developed to facilitate widespread, reliable, cost-effective deployment throughout California. These solutions could lower energy use and demand in buildings due to reduced HVAC and lighting loads while also reducing building owner operating costs.	1e, 1f, 1h, 2a	Progress this year includes developing an improved window system (R-5 performance), prototyping a window-integrated ventilation system to maximize use of natural ventilation, and designing and testing a daylight-redirecting system that increases daylight up to 40 feet from the window. Supporting tools and control systems were also developed to facilitate the design and automated operation of integrated solutions that optimize building electric loads while maintaining occupant comfort. Market outreach activities included collaborating with industry partner Alcoa to work out essential design elements of the window frame for mass manufacturing, and incorporating modeling tools into third-party software such as Honeybee, and LightStanza which are used by industry to develop rating and certification programs for window attachments. Draft final report is anticipated December 2018.
EPC-14-067 Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems	N/A	N/A	Yes; Calif Based Entity	The project provides improved predictive planning and scheduling tools to manage hydroelectric resources that are needed to adapt to increasing vulnerabilities and uncertainties of a changing climate. This project specifically targets powerhouses operated by PG&E.	2a, 3a, 5c	The research team has installed hardware at all four project sites: Grizzly Ridge, Kettle Rock, Buck's Lake, and Humbug and has collected hydrologic data for water years 2016 and 2017. Data from in-situ snowpack measurements helped to improve Snowpack Water Equivalent (SWE) maps by 55%. The team is currently working with PG&E on updating their working model of the Precipitation Runoff Modeling System (PRMS) from version 2 to version 4 using findings from the project. Some of the project results has been already published in the California 4th Climate Change Assessment Report. In the upcoming months, the team will collect hydrologic data for the final water year 2018 of the project and publish two PRMS-related papers.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-068 Evaluation of Cost, Performance and Water Conserving Capability of Hybrid Cooling	Applied Research and Development	This project analyzed the design, performance, and cost of optimized hybrid cooling systems at utility power plant scale to illustrate the potential benefits of hybrid cooling in California. This project uses an existing Excel spreadsheet-based computational tool with the capability of specifying, at an "engineering-level", design parameters for optimized closed-cycle wet, direct dry, and parallel wet/dry hybrid cooling systems. The tool's output is checked against information from participating plants equipped with wet, dry, and hybrid cooling systems. The capability to make rigorous, reliable evaluations of hybrid cooling systems and the trade-offs between economic power production and water resource conservation enables the selection of preferred cooling systems for the economic and environmental benefit of California.	5/13/2015	No	Generation	$581,580	$581,580	$545,174	N/A	$545,174
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-069 Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System	Applied Research and Development	This project advances the understanding of key parameters of long-term energy scenarios and greenhouse gas abatement options in the California energy system. Researchers further developed detailed scenarios and modeling capabilities of the California electricity sector, as well as interactions between the electricity sector and other sectors, and explored the implications of particular policy choices on the electricity system in the medium (2020-2030) and long term (2050). This project provides critical insight into some of the key challenges facing the low carbon transition in the electricity system, the options for addressing these challenges, and the dynamic interactions among these options, which are likely to grow more important over time.	5/13/2015	No	Grid Operations/Market Design	$700,000	$700,000	$629,929	N/A	$629,929
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-070 Wexus Energy and Water Management Mobile Software for the Agricultural Industry	Technology Demonstration and Deployment	This project deploys the Wexus (Water-Energy Nexus) mobile, cloud-based software platform in California's agricultural industry. The Wexus platform leverages existing utility meter infrastructure and helps agribusinesses to quickly assess energy (and water) usage and cost from virtually anywhere on any mobile device. Through customized alerts and reporting, the platform allows farms to quickly respond to changes in energy usage, adjust and optimize equipment in the field, and reduce operational expenses due to energy costs. Through collaboration with project partners, this project will further extend existing water-energy data analysis, visualization and remote controlling capabilities to the Wexus platform to further optimize water-energy resource management in the agribusiness sector.	5/13/2015	No	Demand-side Management	$4,000,000	$4,000,000	$3,226,601	N/A	$3,226,601
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-071 Rotor-Mounted Bat Impact Deterrence System Design and Testing	Applied Research and Development	The project designs and tests (in lab and field) a new bat deterrence system using ultrasound transmitters mounted in an array along the rotor blades, providing complete coverage over the entire rotor/nacelle envelope. A field test study using substantially similar methods to prior bat impact studies is being implemented post-installation at the test site to measure the effectiveness of the new ultrasound system.	5/13/2015	No	Generation	$862,875	$862,875	$642,337	N/A	$642,337

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EPC-14-068 Evaluation of Cost, Performance and Water Conserving Capability of Hybrid Cooling	$0	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Maulbetsch Consulting	Group 4: Ranked # 1
EPC-14-069 Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System	$286,936	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Energy and Environmental Economics, Inc. (E3)	Group 5: Ranked # 3
EPC-14-070 Wexus Energy and Water Management Mobile Software for the Agricultural Industry	$571,397	$0	Wexus Technologies, Incorporated;	$1,000,000	20.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Wexus Technologies, Incorporated	Ranked # 4
EPC-14-071 Rotor-Mounted Bat Impact Deterrence System Design and Testing	$104,801	$0	Frontier Wind; Bruce Walker;	$36,313	4.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-071 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Frontier Wind	Group 6: Ranked # 3

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-068 Evaluation of Cost, Performance and Water Conserving Capability of Hybrid Cooling	N/A	N/A	Yes; Calif Based Entity	Hybrid cooling can save substantial amounts of water compared to the traditional wet cooling systems, although there are increased system costs and potentially reduced hot day generating capacity and annual energy production. The results of this study provide information validated by a computer methodology to determine quantitative estimates of the trade-offs among cooling system cost, annual energy production, and water consumption. State regulatory agencies, power system developers and owners, and community groups can use this information to make informed decisions about the most suitable cooling equipment to use at future steam power generating facilities in California. This will help ensure the appropriate balance among the supply of electrical generation, the cost of electricity, and conserving water resources.	2a, 3a, 4c	The final report was submitted in December of 2017 and published in July 2018 at https://www.energy.ca.gov/2018publications/CEC-500-2018-015/CEC-500-2018-015.pdf. Results included: 1. Validating the tool output against existing cooling systems. The estimates generated by the tool were comparable to the design and performance of existing systems at full-scale power plants. 2. Comparing costs, performance, and water consumption in differing meteorological conditions as illuminated in the case studies. The team concluded that while the installed cost and the turbine output reduction vary significantly with cooling system choice, the annualized costs do not. 3. Projecting effects of using hybrid cooling at California power plants in the future.
EPC-14-069 Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System	N/A	N/A	Yes; Small Business, Calif Based Entity	This project developed options for improving electricity planning methodologies, such that they better incorporate knowledge of how the electricity system will need to evolve over the next 15 to 30 years. The analysis includes a better understanding of how current policy choices will impact long-term climate outcomes, providing critical policy-relevant information to state energy agencies that will be implementing the Governor's energy and climate goals over the next 15 years. The research team estimated the potential costs of reducing GHG emissions by 80% by 2050 and compared these costs with the public health benefits of improved air quality reported by others. They found that the potential public health benefits are in the same order of magnitude than the potential GHG reduction costs.	3f, 4a	The researchers improved their models and data sets, for example, improving the linkage between the E3 model of the electricity system and their PATHWAY model. E3 briefed Chair Weisenmiller and the project's Policy Advisory Committee in November 2017. The final project report is published on the Energy Commission website. Key findings of the long-term energy scenarios research include: 1) renewable power generation needs to exceed the current RPS requirement of 50% set for 2030 if the 2030 emissions reductions goal is to be met; 2) to meet California's 2050 goal of 80% emissions reductions relative to 1990 levels, the electricity system must be comprised of 85-95% zero-carbon electricity by 2050; 3) consumer behavior is the lynchpin to meeting 2030 targets; and 4) additional RD&D is needed to chart a path for hard-to-electrify end-uses (e.g., heavy-duty trucks, industry).
EPC-14-070 Wexus Energy and Water Management Mobile Software for the Agricultural Industry	N/A	N/A	Yes; Calif Based Entity	The Wexus platform uses site data and electric and water utility data to estimate how energy is used on-farm. The data is translated into reports and informs the farmer when to turn off equipment in order to participate in demand response programs. The technology could save farmers about 10% in energy and water bills.	1e, 1f, 1h	The final monitoring and verification (M&V) report, prepared by UC Davis in November 2018 indicated that three of the four participating farms had substantially lower average electricity use during the project period relative to baseline period. After accounting for external factors such as climate, the change in total electricity use was 5.6 percent decrease for the berry farm, 1.8% decrease for the row crop farm, 7.3 percent increase for the dairy farm, and a 12.7 percent decrease for the winery. The increase in the dairy was likely due to uncontrolled variables such as significant variability in pump usage over time, long periods of non-use due to crop irrigation cycles, and unavailable utility data for 2018 (project team working with SCE to address this issue).
EPC-14-071 Rotor-Mounted Bat Impact Deterrence System Design and Testing	N/A	N/A	Yes; Calif Based Entity	This project will create the wind industry's first bat impact deterrent system that can effectively prevent fatal bat interactions with wind turbines. Success of the project has potential to yield a transformational impact on the field of bat impact mitigation. An effective, practical, cost effective system design and test can enable commercialization and broad deployment of this technology. As a system that can be retrofitted into existing turbines and installed in new wind turbines, this technology could materially overcome a significant challenge of the wind power industry by reducing bat fatalities and injuries from turbine strikes while avoiding costly curtailments.	2a, 3a, 4g	Researchers completed the design stage for the system and tested it in their lab. The full system was installed on twelve turbines at Hatchet Ridge in 2016. Bat fatality surveys were conducted on the test turbines and control turbines during the Fall 2016 bat migration season. Power supply problems disrupted the field testing, limiting the amount of useful data. Problems with the power supplies were diagnosed and resolved in 2018, but smoke from the Carr Fire prevented installation in time for the 2018 bat migration season. The team is attempting to secure match funding to cover the cost of completing the bat fatality surveys in 2019 to give a statistically robust estimate of the effectiveness of the system to reduce fatalities.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-073 Monitoring the Urban Heat Island Effect and the Efficiency of Future Countermeasures	Applied Research and Development	This project evaluates the distribution of air temperatures within urban heat islands in California and enhances the foundation for location-specific assessments of mitigation strategies. In collaboration with local governments and organizations in the Los Angeles Basin, the research team designed and implemented siting of fixed high-quality monitoring stations, supplemented with mobile monitoring and data from existing weather-station networks. This research assesses spatial and temporal variations in near-surface air temperature and recasts these observations for use in validating and calibrating the climate/meteorological models applied to assess potential benefits of urban heat island countermeasures throughout the state.	5/13/2015	No	Grid Operations/Market Design	$500,000	$500,000	$500,000	N/A	$500,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-074 Building a Climate Change Resilient Electricity System for Meeting California's Energy and Environmental Goals	Applied Research and Development	The project used climate change simulations to model conditions that disrupt electricity system generation, renewable capacity potential, and demand for the years of 2030, 2040, and 2050. The combined effect of these impacts was then simulated on the electricity system using an integrated electric grid modeling platform to determine the shortfall in achieving California's greenhouse gas emissions goals. The project then analyzed the potential benefits of additional mitigation strategies, such as additional energy storage, on reducing emissions.	5/13/2015	No	Generation	$698,792	$698,792	$661,629	N/A	$661,629
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-075 Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems	Technology Demonstration and Deployment	The University of California at Berkeley, Massachusetts Institute of Technology, and the University of Chicago, have partnered with Lightapp Technologies to demonstrate a pre-commercial, software-based, optimized energy management system in industrial facilities. Together, they will demonstrate Lightapp's energy-monitoring system on compressed air systems in 100 California industrial plants served by the state's investor-owned utilities.	5/13/2015	No	Demand-side Management	$4,981,729	$4,981,729	$4,572,412	N/A	$4,572,412
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-076 Raw Wastewater Filtration to Increase Organic Removal Efficiency and Achieve Significant Electrical Savings	Technology Demonstration and Deployment	This project is extending the application of Cloth Depth Filters (CDF) to raw wastewater filtration at three wastewater treatment plants in California. The CDF concept replaces the current technology of primary clarification by offering the following advantages: (1) substantially higher removal of organic load resulting in significantly lower aeration electrical power demand, and (2) smaller footprint requirements both for primary and secondary treatment steps. CDF employs established principles of gravitational forces which results in minimal operational and maintenance complexities. The unique attribute which offers promise for CDF technology in raw wastewater is the vertical placement of the filter medium and flow direction of this filtration process. Unlike prevailing filtration systems, the vertical orientation of the filter medium permits heavy solids to settle within the tank.	5/13/2015	No	Demand-side Management	$3,476,085	$3,476,085	$2,419,427	N/A	$2,419,427

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EPC-14-073 Monitoring the Urban Heat Island Effect and the Efficiency of Future Countermeasures	$116,818	$0	Altostratus, Inc.;	$4,000	0.8%	Grant	Pre-existing intellectual property identified in agreement EPC-14-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Lawrence Berkeley National Laboratory	Group 7: Ranked # 1
EPC-14-074 Building a Climate Change Resilient Electricity System for Meeting California's Energy and Environmental Goals	$181,613	$0	Southern California Gas Company (SoCalGas); Southern California Edison;	$300,000	30.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-074 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	The Regents of the University of California, Irvine	Group 5: Ranked # 2
EPC-14-075 Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems	$451,253	$0	University of California, Berkeley;	$1,530,590	23.5%	Grant	Pre-existing intellectual property identified in agreement EPC-14-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	The Regents of the University of California, Berkeley	Ranked # 8
EPC-14-076 Raw Wastewater Filtration to Increase Organic Removal Efficiency and Achieve Significant Electrical Savings	$1,184,735	$0	Kennedy/Jenks Consultants; Water Environment Research Foundation; Regents of the University of California (University of California, Davis); Aqua-Aerobic Systems, Inc.; Process Wastewater Technologies LLC; Linda County Water District;	$1,288,340	27.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-076 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Kennedy/Jenks Consultants	Ranked # 5

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EPC-14-073 Monitoring the Urban Heat Island Effect and the Efficiency of Future Countermeasures	N/A	N/A	Yes; Calif Based Entity	Research improves on-the-ground benefits from urban heat island (UHI) mitigation by verifying relationships between the UHI effect and land use/land cover; using these measurements to calibrate and validate models that estimate benefits of mitigation measures; establishing a baseline of today's UHI effect against which the efficacy of future UHI mitigation (cool community) programs can measured; and leaving in place a set of research-grade monitors that can be used to track changes in the UHI effect.	4a	Having successfully engaged the LA Unified School District in siting of research grade weather stations and developed a mobile monitoring platform for monitoring urban heat island (UHI) effects through strategically charted transects, the team completed its collection and analysis of empirical data portraying urban heat island phenomena in the Los Angeles basin. A final report passed the rigorous peer review process associated with California's Fourth Climate Change Assessment. New findings include identification of dominant determinants of urban heat island impacts in the San Fernando Valley and downtown Los Angeles study areas, namely low vegetation canopy cover and low albedo, respectively. Another key contribution was development of a methodological framework for siting weather stations, monitoring urban heat islands, and empirically substantiating strategies to address UHI.
EPC-14-074 Building a Climate Change Resilient Electricity System for Meeting California's Energy and Environmental Goals	N/A	N/A	Yes; Calif Based Entity	The primary benefit of this study was addressing a knowledge gap that has hampered energy planners and policy makers. Previous energy planning studies for the state assumed that future climate would be the same as historical or that climate change would have no impact on the energy system. This study revealed that feedback from climate change could disrupt strategies designed to meet California's greenhouse gas reduction and renewable energy goals for 2050. The study also found that the potential shortfalls caused by climate change could be overcome with existing technologies, perhaps aided by policy changes.	2a, 4a	The project was completed in 2018 and provided an understanding of the specific effects of climate change on the electricity system by 2050 and the resulting ability of the system to satisfy California's GHG reduction target. Because the baseline energy scenario did not account for climate change and fell short of the GHG target, the project team explored a set of energy technologies and resource management strategies to determine if they could offset the shortfall. The project generated a more realistic energy scenario for achieving the 2050 GHG target at the lowest cost. This project was conducted in collaboration with two related studies led by Energy and Environmental Economics (EPC-14-069) and Lawrence Berkeley National Laboratory (EPC-14-072), and results of these three studies have been presented to policy makers and legislative staff. Three journal papers were published.
EPC-14-075 Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems	N/A	N/A	Yes; Calif Based Entity	The Lightapp technology takes an innovative approach by relating electricity use and operating measurements to the production outputs of specific facility systems. This project will monitor the compressed air systems over time, looking at both the supply side (the compressor) and the Demand Side (production). The software tool then identifies anomalies and makes recommendations to lower the overall energy intensity of production and save energy and money. This project demonstrates the operational effectiveness and financial viability of deploying a more developed version of the technology in California industries and optimizes electricity consumption in compressed air systems, a common system in many industries.	1f, 1h, 4a	As of December 6, 2018, 93 installations are completed and communicating baseline data, with 61 sites in the data acquisition phase. When the results of all methods of analysis are averaged together, the demonstration facilities have seen an overall average decrease of 9% of electricity use and monthly savings of $6,728 per facility, equating to a yearly savings of $81,962 per facility.
EPC-14-076 Raw Wastewater Filtration to Increase Organic Removal Efficiency and Achieve Significant Electrical Savings	N/A	N/A	Yes; Calif Based Entity	This project uses cloth depth filtration (CDF) for raw wastewater filtration to reduce the organic load on the secondary wastewater treatment step, which is the most energy intensive step in the treatment process. This breakthrough treatment using CDF has never been tested nor implemented at wastewater treatment plants. The technological breakthrough is proving the effectiveness and technical and economic feasibility of filtering raw wastewater for removal of biosolids before any other wastewater treatment step occurs. A reduction in biosolids loading before the primary and secondary treatment can lead to 35 percent reduction in secondary aeration energy use that will help these plants meet the state's SB 350 goals. The project team includes engineers, consultants end users and others who will work collaboratively to overcome barriers for market acceptance of the CDF technology.	1f, 1h, 4a	The Recipient submitted the Monitoring and Verification (M&V) report for the City of Lancaster demonstration site (100,000 gallon per day system) to the Energy Commission in November 2018. The report is under review but one of the findings indicate that a large primary filtration system capable of processing 15 million gallons per day will reduce secondary aeration power use by 32% (157 kW). The Recipient is analyzing 1.5 yrs. of primary filtration operational data from the Linda County demonstration unit (1.5 million gallons per day system). Preliminary results indicate 25-30% reduction in aeration energy costs and 20-25% increase in secondary treatment capacity. The draft M&V report for Linda County and the City of Manteca (100,000 gallon per day system) is planned for late 2018. The draft final report for the project is also planned for late 2018.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-077 Enable Standardized Vehicle-Grid Integration through Development of Universal Standard	Applied Research and Development	The project was intended to design and develop a Demand Clearing House (DCH) to monitor published energy pricing from the California Independent System Operator's Fifteen-Minute Energy Market as well as load forecasts from San Diego Gas and Electric and other participating utilities through an Application Programming Interface translation from Open ADR 2.0b, a Demand Response protocol used by all California Investor Owned Utilities. The DCH would have then used algorithms that convert grid conditions into ISO/IEC 15118 "grid profiles," or Tariff Tables, which in turn would be communicated to 15118-capable charging stations and vehicles. A fully developed DCH would allow utilities to respond to supplemental energy market prices, proving a viable and scalable pathway toward using plug-in electric vehicles to manage variable grid conditions, solar oversupply, and other system wide challenges. This project was terminated early and will not complete.	6/10/2015	No	Grid Operations/Market Design	$1,499,999	$1,499,999	$356,872	N/A	$356,872
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-078 Next-Generation Grid Communication for Residential PEVs	Applied Research and Development	The project develops communication interfaces between PEV customers and utilities using cloud-to-cloud OpenADR 2.0b communication with a vehicle charging network and will leverage emerging means for retrieving vehicle information via the ISO/IEC 15118 standard for consideration in the decision process. The communication will be able to gather customer data and receive signals from a third party (utility) for the purpose of optimizing PEV charging in a mutually beneficial manner to the customer and the utility. In addition to investigation and implementation of the ISO/IEC 15118 standard, the project will also investigate using control methods that do not require having vehicle charging information. This may be done through statistical estimation, rate of charge output from charging stations or driver opt-in based on maximum charge needed.	6/10/2015	No	Demand-side Management	$1,500,000	$1,500,000	$1,205,218	N/A	$1,205,218
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-079 Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable more Residential Solar Energy	Applied Research and Development	The purpose of this project is to resolve the limiting conditions that occur on California distribution systems when many PV systems are installed behind a single residential distribution transformer by evaluating advanced inverter functionality with specific goal of enabling higher penetration of photovoltaic on the grid. The project is identifying, implementing, and testing (both in lab and field) optimal methods by which smart inverters can mitigate the issues that otherwise would limit local high penetrations of residential PV. The process will identify how California Rule 21 functions can be used and configured so that multiple smart inverters work in harmony and will also identify how other naturally-occurring consumer devices, such as electric vehicle chargers and other smart loads, can serve to further enable high-levels of solar PV.	6/10/2015	No	Grid Operations/Market Design	$1,705,478	$1,705,478	$669,634	N/A	$669,634
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-080 Renewable Microgrid for a Medical Center	Technology Demonstration and Deployment	This project is demonstrating the ability of a microgrid to support and sustain the functions of a healthcare facility and to overcome barriers to its deployment. The Charge Bliss team successfully designed, engineered, procured, constructed, and commissioned the microgrid systems at the Kaiser Permanente Hospital in Richmond, California. This included developing a next-generation microgrid controller capable of optimizing renewable energy generation, storage, and delivery and islanding and providing critical system support.	6/10/2015	No	Distribution	$4,776,171	$4,776,171	$4,135,837	N/A	$4,135,837

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-077 Enable Standardized Vehicle-Grid Integration through Development of Universal Standard	$193,033	$0	Energy Solutions; Center for Sustainable Energy; Broadband Telcom Power Inc.; KnGrid;	$162,474	9.8%	Grant	Pre-existing intellectual property identified in agreement EPC-14-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	Center for Sustainable Energy	Ranked # 2
EPC-14-078 Next-Generation Grid Communication for Residential PEVs	$139,418	$0	ChargePoint, Inc.;	$142,500	8.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-078 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	ChargePoint, Inc.	Ranked # 1
EPC-14-079 Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable more Residential Solar Energy	$400,537	$0	Electric Power Research Institute, Inc.; Sacramento Municipal Utility District; Underwriters Laboratories, Inc.; Southern California Edison Advanced Technology Organization; Intwine Connect; ClipperCreek, INC.; Pentair; A. O. Smith Corporate Technology Center; Emerson Climate Technologies;	$891,414	34.3%	Grant	Pre-existing intellectual property identified in agreement EPC-14-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Electric Power Research Institute, Inc.	Group 3: Ranked # 2
EPC-14-080 Renewable Microgrid for a Medical Center	$729,842	$0	Princeton Power Systems, Inc.; OSISoft, LLC; Kaiser Permanente Medical Center;	$2,095,835	30.5%	Grant	Pre-existing intellectual property identified in agreement EPC-14-080 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Charge Bliss, Inc.	Group 1: Ranked # 4

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-077 Enable Standardized Vehicle-Grid Integration through Development of Universal Standard	N/A	N/A	Yes; Calif Based Entity	Had the project been successful, this project would have advanced the adoption of an open protocol that enables large amounts of new, low cost flexible capacity on the grid. The open protocol could potentially minimize stranded investments in less cost effective forms of flexible grid resources, maximize renewable and PEV integration, and promote a safer, more reliable low carbon future.	2a, 4a, 4b	CSE was unsuccessful in completing this project to develop, test and demonstrate an open-source Demand Clearing House (DCH). CSE experienced numerous project delays due to the loss of a major subcontractor and subsequently their demonstration site. CSE and the Energy Commission determined that the project could not satisfactorily complete before the grant funds expired. These delays ultimately led to the proposed termination of this grant agreement. The only deliverable brought to completion was the DCH Server Specifications, which detail the design capabilities and functionality of the DCH. Work progressed on the DCH software, but was only completed up to 25%. The Server Specifications and "work in progress" software are available to the public for use and continued development. Energy Commission Audit staff concluded their audit and identified unresolved questioned costs.
EPC-14-078 Next-Generation Grid Communication for Residential PEVs	N/A	N/A	Yes; Calif Based Entity	This project will lower or defer costs in upgrading local distribution infrastructure by providing a mechanism for demand management for local distribution networks, specifically managing PEV charging with input from PEV customers, vehicles, and utility signals. The results from this project would allow the utility to optimize a residential customers night time charging while still satisfying the driver mobility needs. The driver will have the same driving experience, generation and transmission resources can be optimized, and the grid costs and emissions can be reduced. ChargePoint determined that pilot participants experienced an average savings of 45 percent and there is potential for increased savings if the participants had increased visibility to monitor their vehicle's SOC, which is enabled by integrating the 15118 standard in the charging station and the PEV.	1g, 1h, 2a, 3f, 4a, 5b	This project was completed in 2018. The final report is going through the Energy Commission's publication process. ChargePoint completed 15118 testing on the Daimler vehicle to send charging schedules to the vehicle and receive them back from the station. The three-month pilot program consisted of 1,005 charging events across 27 drivers in the San Diego Gas and Electric service territory who used the controlled charging schedule 58 percent of the time. Several participants indicated they were interested in using the controlled schedule more if the vehicle's state of charge (SOC) was more visible. Multiple drivers noted that they wished to limit their SOC at 80 percent to take advantage of the vehicle's regenerative braking capabilities or to protect their battery health. ChargePoint determined the pilot participants achieved a 45 percent average bill savings on their vehicle charging.
EPC-14-079 Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable more Residential Solar Energy	N/A	N/A	Yes; Calif Based Entity	As the penetration of autonomous Rule 21 inverters increases, their interactions will grow in importance. This project will help provide a clear understanding of inverter characteristics and of their potential interactions that may help preserve the stability and reliability of the grid, benefiting both consumers and operators. Consumers who invest in solar PV systems (and utilities that provide incentives or expect benefits from PV) wish to maximize the power they can realize from their system. Sharing excess PV generation with local loads may increase the utilization of such systems without negatively impacting the distribution grid.	1b, 3d, 4a, 5a, 5b	The project is currently in the laboratory testing phase. Work on test procedures has revealed inconsistencies among the Rule 21 specifications of the California utilities, leading to concerns about the proper configuration of currently installed inverters. Preliminary laboratory testing to characterize the advanced-function operation of the inverters has identified reliability and behavioral problems that are currently being investigated. New comprehensive test procedures have been developed by the project to investigate these issues and may also provide improved data for modeling advanced function inverters. While currently lacking quantifiable results from the sharing of excess PV production, planning calculations show that a 15% increase in an individual homeowner's PV production would pay back the cost of the equipment required in about one year.
EPC-14-080 Renewable Microgrid for a Medical Center	N/A	N/A	Yes; Micro Business, Calif Based Entity	This project demonstrates the value of a microgrid to healthcare facilities, including the reduction in energy costs, which are substantial for healthcare facilities, and the ability to support life and safety functions for three hours or longer to supplement existing backup generation and improve the energy reliability of hospitals in crisis situations. In collaboration with the governing agency Office of Statewide Health Planning and Development (OSHPD), the CEC and Charge Bliss are forging new methods and standards to support the resiliency and autonomy of critical healthcare facilities. This project helps inform deliberation of the requirement for healthcare facilities to have diesel backup.	1e, 1h, 4a, 5a	In 2018, the Charge Bliss team continued to make adjustments to the microgrid controller software developed under the agreement to optimize the hospital's energy savings and to increase system run time to 98%. There has been a considerable amount of publicity and information shared with the public. Since the opening ceremony, the project has been highlighted in several articles from local media to industry magazines. The team has performed several presentations to interested groups including the California Society of Hospital Engineers (CSHE) and the Hospital Building Safety Board (HBSB), a division of California's Office of Statewide Health Planning and Development (OSHPD). The final report is in final review for publication and expected to be published in next couple of weeks.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-081 Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption	Technology Demonstration and Deployment	This project is demonstrating a software tool that links groundwater extraction with smart meter data to provide growers with automated information on energy and water consumption. This data is augmented by weather data and optional soil moisture data from local sensors to provide information to growers regarding irrigation needs. Use of the software program could help inform growers and reduce irrigation while maintaining or optimizing yield. This technology is being applied over 1,000 acres of farms owned by several growers of alfalfa, tomato, pistachios and almonds.	6/10/2015	No	Demand-side Management	$2,292,829	$2,292,829	$2,250,763	N/A	$2,250,763
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	Technology Demonstration and Deployment	This project is deploying a biomass-fired combined heat and power system to provide heat and power to Plumas County health facilities. Biomass from local forest clearing operations will be used by a new biomass boiler to supply heat to an Organic Rankine Cycle (ORC) power unit. Waste heat from the ORC will be used as a heat source for heat pumps, improving their performance for the winter heating season.	6/10/2015	No	Generation	$2,603,228	$2,603,228	$2,208,089	N/A	$2,208,089
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	Technology Demonstration and Deployment	This project is deploying a biomass-fired combined heat and power system to provide heat and power to Plumas County health facilities. Biomass from local forest clearing operations will be used by a new biomass boiler to supply heat to an Organic Rankine Cycle (ORC) power unit. Waste heat from the ORC will be used as a heat source for heat pumps, improving their performance for the winter heating season.	6/10/2015	No	Generation	-$217,967	-$217,967	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-084 ABEC #4 Renewable Combined Heat and Power Project	Technology Demonstration and Deployment	The project uses biogas derived from on-site dairy manure to generate low-carbon, renewable electricity and achieve high overall efficiency by capturing waste heat from the power generation system, and uses it to drive an absorption chiller. The absorption chiller is designed to convert waste heat into chilling capacity, which will be used to chill milk produced by the dairy cows. New absorption chiller capacity directly offsets electricity consumption from existing electric chillers. Combining renewable generation with waste heat collection and cooling, the project increases energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand.	6/10/2015	No	Generation	$3,000,000	$3,000,000	$2,673,175	N/A	$2,673,175
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-085 Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System	Technology Demonstration and Deployment	This project is demonstrating that the combination of advanced PV generation and an energy management system can reduce the community's average daily power and daily peak energy demand by more than 10%. The project includes a smart electrical energy storage system that integrates retired electric vehicle batteries. The generator and storage system are controlled by a commercial-grade microgrid controller, with the three levels of hierarchy. The demonstration site is located in the Robert Mondavi Institute at the UC Davis campus.	6/10/2015	No	Generation	$1,238,491	$1,238,491	$18,284	N/A	$18,284

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-081 Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption	$332,162	$0	UC Santa Barbara; UC Davis; PowWow Energy, Inc.;	$535,568	18.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-081 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	PowWow Energy, Inc.	Ranked # 1
EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	$262,813	$0	Plumas County; Sierra Institute for Community and Environment;	$652,400	19.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	Sierra Institute for Community and Environment	Group 2: Ranked # 2
EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	$0	$0	Plumas County; Sierra Institute for Community and Environment;	-$59,084	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	Sierra Institute for Community and Environment	Group 2: Ranked # 2
EPC-14-084 ABEC #4 Renewable Combined Heat and Power Project	$32,107	$0	ABEC #4 LLC CEandS Dairy Biogas;	$4,983,619	62.4%	Grant	Pre-existing intellectual property identified in agreement EPC-14-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 23 bidders	ABEC #4 LLC CE&S Dairy Biogas	Group 2: Ranked # 1
EPC-14-085 Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System	$124,883	$0	UC Davis; OSISoft, LLC; Solexel;	$658,729	34.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	UC Davis	Group 2: Ranked # 5

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-081 Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption	N/A	N/A	Yes; Small Business, Calif Based Entity	Reduced irrigation techniques have not been adopted by growers because of perceived risks associated with lower crop yield and quality, and lack of equipment and labor to measure water consumption. This project is developing a unique software tool for measuring groundwater extraction and water application, by leveraging smart meter data, as well as existing water data in the cloud and at the farm sites. The tool is unique because it uses smartmeter data to measure water volumes from pumps without installing hardware devices on site. The tool also communicates with the farmer and irrigator to optimize crop yields and water applications.	1f, 1h, 4a, 4c	The project demonstrated on average 13% improvement in energy efficiency (energy savings for the same level of production performance) across a variety of crops and geographies. Project also achieved 9% in water use efficiency improvement (water savings for the same level of yield). If this innovation was implemented successfully across 20% of the farms in California, an estimated annual reduction of more than 66 GWh and 120,000 acre-feet in water use could be achieved. This project also demonstrated that smart meter data can be used to provide daily water records that help with water management on the farm. The project team continues to work with California electric utilities and host on farm workshops to engage new clients. This technology was used to document energy and water savings in the California Department of Food Agriculture's State Water Efficiency and Enhancement Program.
EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	N/A	N/A	Yes; Calif Based Entity	This project will link emerging technology with new, innovative opportunities to advance renewable energy, distributed generation, and create clean energy jobs. The first-of-its-kind project combines a biomass-fired boiler with an Organic Rankine Cycle electric generator that diverts waste heat to source heat pumps supplying economical heat and power to a community-scale entity currently experiencing high energy costs. The project will help sustain a market for locally-sourced, sustainable forest biomass, providing jobs to the community and helping to reduce the risk of catastrophic wildfires that threaten transmission infrastructure and public safety. The project will serve as a template for other rural communities as how to combine emerging technologies in unique ways to address local energy needs using local fuels and reducing their need for grid electricity and fossil fuels.	1f, 1h, 4a, 4b	Facility construction occurred in first and second quarters of 2018, and all equipment was installed and commissioning completed by June, 2018. A ribbon cutting ceremony was held on April 6 which included participants from the Sierra Institute, Plumas County, US Forest Service, community advocates, project developers and the Energy Commission. Over the summer and early fall of 2018, Sierra Institute secured a steady fuel supply and trained County technicians to operate the system. Currently the project is addressing minor shakedown issues and will commence regular data collection as soon as those are resolved.
EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	N/A	N/A	Yes; Calif Based Entity	This project will link emerging technology with new, innovative opportunities to advance renewable energy, distributed generation, and create clean energy jobs. The first-of-its-kind project combines a biomass-fired boiler with an Organic Rankine Cycle electric generator that diverts waste heat to source heat pumps supplying economical heat and power to a community-scale entity currently experiencing high energy costs. The project will help sustain a market for locally-sourced, sustainable forest biomass, providing jobs to the community and helping to reduce the risk of catastrophic wildfires that threaten transmission infrastructure and public safety. The project will serve as a template for other rural communities as how to combine emerging technologies in unique ways to address local energy needs using local fuels and reducing their need for grid electricity and fossil fuels.	1f, 1h, 4a, 4b	Facility construction occurred in first and second quarters of 2018, and all equipment was installed and commissioning completed by June, 2018. A ribbon cutting ceremony was held on April 6 which included participants from the Sierra Institute, Plumas County, US Forest Service, community advocates, project developers and the Energy Commission. Over the summer and early fall of 2018, Sierra Institute secured a steady fuel supply and trained County technicians to operate the system. Currently the project is addressing minor shakedown issues and will commence regular data collection as soon as those are resolved.
EPC-14-084 ABEC #4 Renewable Combined Heat and Power Project	N/A	N/A	Yes; Calif Based Entity	The project represents a significant advance in dairy energy management by combining renewable generation with waste heat collection and cooling to increase energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand. The project benefits include substantial reductions in greenhouse gas emissions, lower manure handling costs, and generation and distribution of technical and economic data on community scale power production.	3a, 4a, 4e	The project broke ground in fall 2016 and construction is complete. A TAC was held in October, 2017 followed by a CPR in November. The project accepted a PG&E BioMAT Power Purchase Agreement and began testing in fourth quarter 2017 with full operation and data collection beginning in first quarter 2018. Monthly invoicing and progress reports are being submitted and the project is expected to complete as planned.
EPC-14-085 Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System	N/A	N/A	Yes; Calif Based Entity	The combination of advanced PV and energy management systems will result in significant reduction in annual grid electricity consumption - estimated at over 80% or a cost savings of roughly $29,000 per year with associated greenhouse gas reductions of about 250 tons per year. Furthermore, the success of this project will provide follow-on benefits to California's large wine industry by proving that winemaking can be an environmentally-friendly process.	1b, 1e, 1f, 1h, 2a, 3b, 4a	In 2018, the project had delays in site construction design but continued work in parallel on equipment integration, controls, lab work and historical data collection. A no-cost extension was executed and the project is now back on track. The project team has now completed the construction and installation of the solar panels and battery energy storage system. The modified shipping container for battery energy storage system has been delivered and is fully integrated. The solar PV system has been commissioned and is operational. The research team is in the process of transporting and installing the battery system in the modified shipping container, which was slightly delayed due to campus shutdown due to poor air quality (smoke).

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-086 Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability	Applied Research and Development	The project developed an integrated vehicle-to-grid (V2G) system that was tested and demonstrated to be distribution-aware, self-regulating, interoperable, secure and open as well as scalable and flexible. These real-world test and demonstration results can provide confidence in the V2G systems that provide grid support functions and possibly influence investor owned utilities (IOUs) to add them to their Assembly Bill 2514 Storage Mandate compliance plans. The data gathered and analysis validated the cost effectiveness models through direct engagement with the IOUs' existing infrastructure and distribution networks, combined with simulated independent system operator interaction.	6/10/2015	No	Grid Operations/Market Design	$1,499,977	$1,499,977	$977,726	N/A	$977,726
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-088 Demonstration of Low-Cost Liquid Cooling Technology for Data Centers	Technology Demonstration and Deployment	This project is validating the performance, reliability, cost savings and payback of a data center efficiency technology that uses direct-to-chip liquid-cooling to cut data center cooling energy use. The technology is being demonstrated at two full scale data centers with the goal of minimal operational disruptions during installation. Energy consumption, load, reliability and server performance are being monitored. The results of the demonstrations, along with "lessons learned", will be made broadly available to the data center community and public-policy makers to stimulate adoption of this technology.	6/10/2015	No	Demand-side Management	$3,552,678	$3,552,678	$2,664,212	N/A	$2,664,212
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-003 Demonstration of Community Scale Generation System at the Chemehuevi Community Center	Technology Demonstration and Deployment	This project deploys and demonstrates a community energy generation system at the Chemehuevi Indian Tribe Community Center. The energy system incorporates two pre-commercial solar technologies with flow-battery energy storage integrated with energy management system. The integration of the energy management system components will reduce peak energy demand for the center by utilizing battery storage to shift building and community loads and provides an uninterruptable power for the center when it is used as an Emergency Response Center for the tribe.	10/14/2015	No	Distribution	$2,588,906	$2,588,906	$1,412,506	N/A	$1,412,506
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-004 Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand	Applied Research and Development	This project is developing and demonstrating a Climate Appropriate Air Conditioning system for commercial buildings that optimizes occupant comfort and can reduce energy use and peak demand. The project will apply a combination of Variable Refrigerant Flow (VRF) technology with Indirect Evaporative Cooling (IEC) integrated and operationally optimized through the building control system. The project will also investigate alternative non- Ozone Depleting Potential (ODP) or low global warming (GWP)refrigerants and HVAC system designs that could enable their usage in commercial buildings. This project will benefit small and medium commercial buildings, such as retail stores, offices buildings and food service and could be implemented in existing and new commercial buildings through direct replacement of rooftop packaged air conditioners. It is estimated that the HVAC systems for these sectors use 7,000 GWh and contributes 5 GW of peak demand.	7/8/2015	No	Demand-side Management	$2,834,721	$2,834,721	$918,818	N/A	$918,818

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EPC-14-086 Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability	$666,988	$0	Electric Power Research Institute, Inc.;	$795,754	34.7%	Grant	Pre-existing intellectual property identified in agreement EPC-14-086 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	Electric Power Research Institute, Inc.	Ranked # 3
EPC-14-088 Demonstration of Low-Cost Liquid Cooling Technology for Data Centers	$1,038,931	$0	Lawrence Livermore National Laboratory; Asetek USA, Inc.;	$1,519,738	30.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Asetek USA, Inc.	Ranked # 3
EPC-15-003 Demonstration of Community Scale Generation System at the Chemehuevi Community Center	$525,157	$0	Primus Power; The Regents of the University of California - Riverside; OSISoft, LLC; Solexel; Chemehuevi Indian Tribe; SunPower Corporation, Systems;	$706,698	21.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	The Regents of the University of California - Riverside	Group 2: Ranked # 3
EPC-15-004 Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand	$1,088,673	$0	Electric Power Research Institute, Inc.;	$440,509	13.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 9

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-086 Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability	N/A	N/A	Yes; Calif Based Entity	PEVs with integrated V2G systems have the potential to simultaneously improve air quality, reduce vehicle operational costs and to reduce grid stress and increase grid reliability and stability. Monitoring at the transformer level with control of V2G provides enhanced local situational awareness and real-time responsiveness to distribution grid conditions. The developed management and monitoring system will have awareness of load, power, temperature, current, voltage, frequency, and PEV customer constraints--information to be utilized to determine need for V2G resource. This approach provides a potentially significant solution for integration of a viable energy efficient energy storage technology into a decentralized grid structure, and with the ability to operate as a unified distributed energy resource aggregation system.	1c, 1e, 2a, 3f	This project was completed in 2018. The final report is undergoing the Energy Commission publication process. EPRI developed an end-to-end capable V2G system that demonstrated grid condition awareness in a safe and outage-immune method. Aerovironment and Kitu completed integration and assembly of J3072 and SEP 2.0b software into the 10 demonstration EVSEs. The research team developed the on-board V2G communication module for the PEV and demonstrated the functionality at UCSD. The value analysis showed a cumulative maximum benefit to the grid (net of cost increment) to range between $450-$1,850/year per vehicle in defrayed or deferred infrastructure upgrade costs, which is about five times more valuable than smart charging for similar grid service applications. The project partners, including the University of Delaware and U.S. DOE, are using the findings to further advance VGI research.
EPC-14-088 Demonstration of Low-Cost Liquid Cooling Technology for Data Centers	N/A	N/A	Yes; Calif Based Entity	If successful, the project will validate the performance, reliability, cost savings and payback of a data center efficiency technology that could reduce cooling costs while being able to be installed as a retrofit. This could lead to overcoming barriers to adoption by minimizing operational disruptions and costs compared with conventional installations and retrofits.	1f, 1h, 4a	Data collection for both Lawrence Livermore National Lab buildings have been completed. Analysis of the data and drafting of the final report is underway and the draft final report due to the Energy Commission by 12/31/18.
EPC-15-003 Demonstration of Community Scale Generation System at the Chemehuevi Community Center	N/A	N/A	Yes; Calif Based Entity	The project will result in greater electricity reliability, lower electricity costs, reduced peak energy demand and avoidance of failures and outages by integrating a scalable system in both size and quantity and demonstrating the commercial feasibility to deploy many megawatt hours of dispatchable energy integrated in a photovoltaic/battery storage configuration.	1e, 1g, 1h, 2a, 3f, 4a, 5a	The project has deployed an energy generation system at the Chemehuevi Indian Tribe Community Center. The system incorporates a 90.36 kW solar PV system and a 25 kW/125 kW-hour (kWh) flow-battery energy storage system integrated with energy management system to offset the center energy consumption of 102,000 kWh/year and manage peak energy demand by utilizing battery storage to shift building and community loads and provides an uninterruptable power for the center when it is used as an Emergency Response Center for the tribe. As of 11/15/2018 the system is operational and connected to grid after signing an interconnection agreement with SCE. The next step is to evaluate the most favorable rate schedule for the community center and to go through the process to participate in a demand response program. A ribbon-cutting ceremony for the project is anticipated in January 2019.
EPC-15-004 Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand	N/A	N/A	Yes; Calif Based Entity	The technology advancement is the intelligent HVAC controller that processes signals from building sensors and system feed-back to maximize system efficiency while also synchronizing operation of the VRF and IEC to reduce energy use and peak energy demand and maximize occupant comfort. The innovative control system utilizes cloud based optimization using weather, grid conditions and occupancy (CO2) as inputs to optimally operate a VRF and the IEC system to reduce both energy and water use. The IEC will be set up as a dedicated outdoor air system and incorporate variable speed blower and heat recovery ventilation. These subsystems will also be intelligently controlled by the building controller. This project will also evaluate and provide system designs that use alternative refrigerants that have zero ODP or low GWP.	1f, 1h, 4a	EPRI has finalized the test sites for this project and they include: Western Cooling Efficiency Center in Davis, two fast food restaurants in Aliso Viejo and an office building in San Diego. The Davis site will add indirect evaporative cooling and the San Diego site has just added a new variable refrigerant flow (VRF) loop to work in conjunction with the current evaporative cooling. The Aliso Viejo site will add both evaporative cooling and a variable refrigerant loop. The new VRF in San Diego has been undergoing commissioning. The recipient is collecting data at the Davis and Aliso Viejo sites to establish baseline conditions prior to equipment installation. Approximately 12 months of monitoring and verification is planned. The alternative refrigerant work is continuing and testing is underway for a new propane, CO2 and ammonia units along with work on the model and control system.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-005 Potential Impacts and Adaptation Options for the Electricity System from Sea Level Rise in the San Diego Area.	Applied Research and Development	The project evaluated SLR vulnerability and adaptation options in the SDG&E service area at a level of detail appropriate for informing electricity sector policy and planning. ICF International partnered with SDG&E to conduct a detailed and robust sea level rise vulnerability assessment and to identify and evaluate appropriate adaptation measures. This project identified adaptation measures for the electrical system that are actionable and aligned with existing policies, based on a comprehensive understanding of the vulnerabilities of specific assets, how these combine at a system level, and significant feedback from the utilities. The results were formed with significant input from the IOU to ensure the adaptation measures are actionable.	10/14/2015	No	Generation	$499,929	$499,929	$478,037	N/A	$478,037
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-006 Modeling the Impact of Wildfires on California's Transmission and Distribution Grid	Applied Research and Development	This study advanced scientific knowledge by combining and enhancing several state-of-the-art models to produce the most detailed analysis to-date of California's current and future electric transmission and distribution grid and fire risk under alternative conditions of climate change and grid evolution.	10/14/2015	No	Distribution	$500,000	$500,000	$500,000	N/A	$500,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-007 Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat	Applied Research and Development	This project developed a sophisticated description of future electric grid demand, response, and vulnerability due to increased (and prolonged) heat events in Southern California Edison territory under current and future climate scenarios. It will enable innovative grid management and operation strategies and will identify adaptation guidance. Researchers provided the information to local governments, regional and state agencies, utilities, and the general public in tangible, easy-to-understand policy briefs to enhance local and state capacity to respond to potential disruptions in distribution due to climate change.	10/14/2015	No	Distribution	$500,000	$500,000	$357,753	N/A	$357,753
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-008 Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt	Applied Research and Development	This project develops a suite of analytical and outreach approaches to provide electricity system stakeholders with actionable data pertaining to local climate risks. The project is organized around three imperatives. The first is developing interactive, visually compelling, and useful web-based visualization applications depicting climate-related risks to the electricity infrastructure. The second is to build focused toolsets to support planning to protect energy infrastructure. Finally, the project includes outreach and training with energy stakeholders, climate practitioners, planners, managers, educators and ratepayers in the state through targeted workshops, webinars, and presentations. As articulated by electricity sector IOUs in the 2017 IEPR Adaptation Workshop, Cal-Adapt 2.0 is an instrumental tool for developing and implementing locally appropriate adaptation options in the electricity sector.	11/12/2015	No	Grid Operations/Market Design	$400,000	$400,000	$398,891	N/A	$398,891

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-005 Potential Impacts and Adaptation Options for the Electricity System from Sea Level Rise in the San Diego Area.	$240,425	$0	San Diego Gas and Electric Company;	$166,200	25.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	ICF Incorporated, L.L.C.	Group 1: Ranked # 1
EPC-15-006 Modeling the Impact of Wildfires on California's Transmission and Distribution Grid	$169,786	$0	University of Hawaii at Manoa;	$17,157	3.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1
EPC-15-007 Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat	$84,000	$0	County of Los Angeles; The Regents of the University of California, Los Angeles;	$183,753	26.9%	Grant	Pre-existing intellectual property identified in agreement EPC-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	The Regents of the University of California, Los Angeles	Group 3: Ranked # 1
EPC-15-008 Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt	$74,324	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	The Regents of the University of California, Berkeley	Group 4: Ranked # 1

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EPC-15-005 Potential Impacts and Adaptation Options for the Electricity System from Sea Level Rise in the San Diego Area.	N/A	N/A	Yes; Calif Based Entity	Detailed SLR inundation modeling that builds on previous studies is used to identify the SDG&E infrastructure that will be exposed to coastal flooding and assess how the electricity system could be affected. Impacts of coastal inundation and possible adaptation measures are determined using literature reviews, interviews with key experts, modeling, and workshop elicitation. Potential direct and indirect impacts are used at an asset-by-asset level and through system-wide assessment, including power flow modeling to support a "value of lost load" analysis. This level of information was not previously available to SDG&E for use in its planning.	5a, 5d	Working closely with SDG&E, the research team first collected information on specific infrastructure assets and operations, and identified potential climate impacts. The climate impact vulnerabilities of the electricity system were then identified and discussed with the utilities. A matrix of assets and electricity service categories was developed in 2016. The research team collected information on electricity system adaptation measures and presented them to the utilities at a series of workshops to obtain feedback in summer and fall of 2017. The utilities are already using some of the results from this study for adaptation planning.
EPC-15-006 Modeling the Impact of Wildfires on California's Transmission and Distribution Grid	N/A	N/A	Yes; Calif Based Entity	The project identified segments of the electric grid that are now or will become most vulnerable to increasing wildfire risk. This knowledge allows operators to improve maintenance of grid reliability and safety while adapting to the challenge of changing climate. Researchers applied a unique methodology to measure wildfire risk, allowing them to relate an evolving wildfire probability over time with an evolving electricity grid. The methodology analyzed the cost benefits of grid adaptations for minimizing the risk associated with future wildfires.	2a, 5a, 5d	This project was completed in 2018. The final report, included in California's Fourth Climate Change Assessment, is available online at http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-002.pdf. The researchers obtained the maps of future burned area being used for California's Fourth Climate Change Assessment as the basis for their study of future risk to the transmission and distribution system. They mapped current and future exposure of operationally significant segments of transmission paths to wildfire. They used land use projections of urban expansion as a proxy for the extension of the distribution grid. Then they used the PLEXOS model to estimate the cost of fire-caused outages with and without wildfire forecasts, such as the change in generation costs as other power plants are dispatched to replace the stranded generators during the outage.
EPC-15-007 Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat	N/A	N/A	Yes; Calif Based Entity	The project integrated a set of models in a novel way to link new results on extreme heat events in Los Angeles County with electricity demand projections that respond to these events and then to model how these climate impacts would affect the vulnerability of electricity supply and the transmission and distribution networks. Doing so created a greater level of understanding on where the grid is most vulnerable, which neighborhoods each circuit serves, and what types of adaptation measures may need to be taken by the utility as well as state, regional, and local actors. The project can equally help guide investments in distributed generation that could alleviate pressure on the conventional electricity generation system.	1e, 2a, 5a, 5d	This project was completed in 2018. The final report is available online as part of California's Fourth Climate Change Assessment at http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-013.pdf. The research team projected peak demand for Los Angeles County due to climate change. An 8-11% increase of substation capacity, DER, or peak load shifting will be needed throughout Los Angeles County to keep substation load factors at or below 1 during the worst-case heat waves by 2060. The team conducted an extensive outreach effort to inform utilities and others. The team is briefing CPUC for R.18-04-019 on strategies and guidance for climate change adaptation. Three journal papers will be published. The South Bay Cities Council of Governments intends to use the electricity demand and grid vulnerability projections in developing their climate action plan.
EPC-15-008 Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt	N/A	N/A	Yes; Calif Based Entity	Cal-Adapt provides integrated tools that directly support electricity sector decision making with regard to infrastructure planning and management. Moreover, Cal-Adapt 2.0 coheres with the Governor's Office of Planning and Research's adaptation guidelines and is a key resource for accessing the data prescribed by those guidelines. Use of Cal-Adapt 2.0 to plan for climate resilience contributes multiple benefits to California's electricity ratepayers by helping to stabilize the grid, improve service reliability, and reduce financial losses associated with power outages.	5a, 5d	The research team released version 2.0 of Cal-Adapt, which includes more powerful visualization tools, new datasets, improved access to data, and a public platform for development of custom tools. New data include higher-resolution projections of temperature and precipitation designed to capture extremes as well as a hydrodynamical dataset for exploring potential inundation associated with sea level rise along the entire California coast, and the Bay Area and Sacramento/San Joaquin Delta. The Cal-Adapt team also developed several aggregation and data download options, as requested by the Technical Advisory Committee, which includes utilities and CAISO. Pursuant to a User Needs Assessment Workshop to capture electricity sector needs, Cal-Adapt launched a stream flow tool and improved existing tools (e.g., "quick stats" and historical modeled data download) to support IOU analyses.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-009 Workforce Instruction for Standards and Efficiency (WISE)	Market Facilitation	This project is providing education, outreach, and resources for California's new residential building industry on high performance attics (HPAs) and high performance walls (HPWs), two new requirements in the state's 2016 Building Energy Efficiency Standards. The project helps the new residential building industry to better understand new requirements and options for compliance, and provides them with technical support to enable the transition to the new requirements. Additionally, the project team provides on-the-job training to homebuilders, installing trades, subcontractors, and field crews, on the proper installation of insulation, and on changes to other building systems that will be necessary to meet the new requirements.	11/12/2015	No	Demand-side Management	$4,431,918	$4,431,918	$2,292,572	N/A	$2,292,572
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-010 Expanding Energy-Related Career Pathways in the Electrical Industry: Increasing Workforce Development Opportunities in Disadvantaged Communities and Delivering Training on Automated Demand Response Communication Equipment to Inside Wireman Apprentices	Market Facilitation	The project is recruiting workers from disadvantaged communities into apprenticeship programs at California Joint Apprentice Training Centers (JATCs), providing them with comprehensive classroom and on-the-job training on the installation and maintenance of AutoDR communications equipment. By addressing the acute skills gap by producing a workforce qualified to install and maintain cutting-edge AutoDR communications equipment, the project is enabling demand response to be deployed in the market at scale.	11/12/2015	No	Demand-side Management	$4,476,189	$4,476,189	$1,719,852	N/A	$1,719,852
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-012 Improving Membrane Treatment Energy Efficiency through Monitoring the Removal of Colloidal Particle Foulants	Technology Demonstration and Deployment	The project is demonstrating an online monitoring technology for wastewater treatment plants to directly measure colloidal particle concentrations in order to lower membrane fouling and reduce energy use and maintenance costs. Direct detection of colloidal particles will help determine the optimal pretreatment needed to minimize deposition of colloidal particles in membrane pores.	12/9/2015	No	Demand-side Management	$1,167,034	$1,167,034	$622,040	N/A	$622,040
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-013 Open Source Platform For Plug-in Electric Vehicle Smart Charging in California	Applied Research and Development	The project develops a one-way charging concept for PEVs that maximizes accommodation of intermittent renewable generation and minimizes impacts to the distribution grid. The project focuses on controlling the charging of PEVs in residential and small commercial settings using a novel and flexible open-source, open-software architecture charge communication and control platform. This software-based platform will be embedded in the context of overall utility and residential/business electrical and building automation systems, lending itself to potential broad implementation by commercial interests due to its flexible architecture and "agnostic" approach to communications standards. Control strategies and applications will be guided by an assessment of user needs and grid operation and ratepayer benefits, and the potential for one-way PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid.	2/10/2016	No	Demand-side Management	$1,500,000	$1,500,000	$918,169	N/A	$918,169

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EPC-15-009 Workforce Instruction for Standards and Efficiency (WISE)	$1,667,291	$0	ConSol ; BASF; Owens Corning; KB Home; California Building Industry Association (CBIA); APA - Engineered Wood Association; Bayer Material Science; Ensoltis Green Hybrid Roofing; Panasonic Eco Solutions North America; PCBC; QC Manufacturing; Shea Homes; SIPA - Structural Insulated Panel Association; SPFA - Spray Polyurethane Foam Alliance; Taylor Morrison Homes of California, LLC;	$15,685,075	78.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	California Homebuilding Foundation (CHF)	Group 1: Ranked # 1
EPC-15-010 Expanding Energy-Related Career Pathways in the Electrical Industry: Increasing Workforce Development Opportunities in Disadvantaged Communities and Delivering Training on Automated Demand Response Communication Equipment to Inside Wireman Apprentices	$863,874	$0	California LMCC IBEW-NECA;	$16,165,080	78.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	Center for Sustainable Energy	Group 2: Ranked # 1
EPC-15-012 Improving Membrane Treatment Energy Efficiency through Monitoring the Removal of Colloidal Particle Foulants	$429,784	$0	Orange County Water District; West Basin Municipal Water District; Evoqua Water Technologies; Malvern;	$336,000	22.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Kennedy/Jenks Consultants	Ranked # 9
EPC-15-013 Open Source Platform For Plug-in Electric Vehicle Smart Charging in California	$549,477	$0	BMW of North America;	$90,000	5.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	The Regents of the University of California, Berkeley	Ranked # 4

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EPC-15-009 Workforce Instruction for Standards and Efficiency (WISE)	N/A	N/A	Yes; Calif Based Entity	The California Energy Code now requires new homes to be constructed with HPAs/HPWs, to meet energy efficiency standards. This project helps overcome market barriers for HPAs/HPWs by providing the construction industry with access to on-the-job training and tools on the best available technologies, techniques, and practices for complying with the new requirements.	1c, 1e, 1f, 1h, 2a, 3c, 4a, 4b	The team provided training and technical support to the building industry on HPA/HPW practices, including impacts of the 2019 Title 24 requirements on code compliance. This included a two-day classroom and hands-on training at a Passive House (built for high energy efficiency), educating industry participants on compliance options and proper installation techniques. Training modules were developed for a new online certification through High Performance Insulation Professionals. Informational materials and success stories were also updated on the project website: www.wisewarehouse.org. Finally, a new HPA/HPW curriculum was developed for the Building Industry Technology Academy, a statewide high school program that incorporated it into their annual build challenge for Southern California. The team will continue offering training and scale-up measurement and verification activities in 2019.
EPC-15-010 Expanding Energy-Related Career Pathways in the Electrical Industry: Increasing Workforce Development Opportunities in Disadvantaged Communities and Delivering Training on Automated Demand Response Communication Equipment to Inside Wireman Apprentices	N/A	N/A	Yes; Calif Based Entity	The California Energy Code was updated in 2013 to require lighting systems in large buildings to be capable of receiving and automatically responding to at least one standards-based messaging protocol which enables demand response. This project is helping ensure a workforce that is trained in the proper installation and maintenance of AutoDR communications equipment exists to meet California Energy Code requirements for commercial buildings.	1e, 1g, 1h, 2a, 3f	In 2018, all of the JATCs continued their online courses, and the Sacramento, San Leandro, and Orange County JATCs began in-person courses. Meanwhile, the Los Angeles JATC prepared the lab space for in-person courses. CSE refined course materials per student feedback, and continued developing and revising outreach materials for contractors and apprentices. Through November 2018, a total of 588 students have completed the course either in-person or online, and enrollment for 2019 continues to grow. CSE also worked with local organizations in DACs to recruit for the training program. Additionally, the team finalized a Measurement and Verification plan and began implementation to evaluate the success of the project. Learn more about this project at: http://energycenter.org/demand-response
EPC-15-012 Improving Membrane Treatment Energy Efficiency through Monitoring the Removal of Colloidal Particle Foulants	N/A	N/A	Yes; Calif Based Entity	Nationwide there are over 100 microfiltration/ultrafiltration treatment plants and there are over 100 reverse osmosis facilities in California using membranes. Membrane treatment for wastewater treatment is very energy intensive due to fouling of membranes over time. This project could overcome the barriers to use of membrane treatment by demonstrating a technology that can detect colloidal particles in membrane feed water. This can facilitate an optimal pretreatment process for their removal and reduce membrane fouling and energy costs.	1f, 1h, 4c	The contractor has completed demonstration of this technology at two sites (Orange County Water District and West Basin Municipal Water District). Southern California Edison staff conducted the measurement and verification testing. Testing over multiple clean-in-place (CIP) cycles demonstrated that, the transmembrane pressure (TMP), and hence, the energy consumption, in the pilot retrofitted with the proposed technology was 70% lower than the control pilot unit. Tests were also performed to identify potential unintended consequence of accidental release of high dose of coagulants during membrane treatment. These tests indicated that, addition of coagulant did not increase the levels of aluminum, a key constituent of the coagulant, in the treated water. The contractor will send the draft final report by January 31, 2019.
EPC-15-013 Open Source Platform For Plug-in Electric Vehicle Smart Charging in California	N/A	N/A	Yes; Calif Based Entity	This project focuses on controlling the charging of plug-in electric vehicles PEVs at residential and small commercial settings using a novel and flexible open-source, open-architecture charge communication and control platform. This XBOS-V platform is embedded in the context of overall utility and residential/business electrical and building automation systems, lending itself to potential broad implementation by commercial interests. This integrated project also focuses on the development of the open-source platform including assessment of user needs and grid operation and ratepayer benefits, grid security considerations, and the potential for PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid. The platform is flexible to adoption/inclusion of several communication protocols.	2a, 3h, 4a	The project team is refining the software development strategy, developing functional specifications, and developing the physical test-bed. All the test-bed technical elements were installed and integrated into the XBOS platform with ongoing physical testing. The devices include the electricity panel energy monitoring device, the smart PEV charger, baseboard thermostat control units, smart lighting units, and additional Wi-Fi enabled plug-load controllers. The project team is continuing work on algorithms to manage PEV charging to ease congestion at the distribution level through localized control and charge management and address the potential larger grid values of VGI. The ongoing extend grid conditions and VGI analyses using PEV adoption scenarios through 2030 includes the potential for flexible loads from PEVs to reduce potential future curtailment of "excess" renewable energy.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-015 Grid Communication Interface for Smart Electric Vehicle Services Research and Development	Applied Research and Development	Andromeda Power is developing an advanced smart grid communication interface that allows utilities to send dispatch signals to PEVs in real-time to optimize the bidirectional power flow of PEV battery packs depending on local power conditions such as congestion, power quality, voltage and frequency, while maintaining the driver's mobility needs. The grid communication interface operates with a virtual machine able to interface PEVs of any standard. The real time monitoring and control of the stations will provide to the California Electrical Investor Owned Utilities a means of quick Automated Demand Response.	1/13/2016	No	Demand-side Management	$681,693	$681,693	$573,621	N/A	$573,621
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-016 A Transformative Flywheel R&D Project	Applied Research and Development	This project developed advanced manufacturing processes and improved the flywheel rotor geometries. The project built on developments that the Amber Kinetics flywheel team has made in the areas of enhanced materials processing for better strength, longer life, and improved rotor geometries to maximize energy storage density and reduce the costs. The team also conducted extensive performance testing.	1/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$1,797,868	N/A	$1,797,868
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-018 Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems	Applied Research and Development	The goal of this project is to develop and test behind-the-meter residential and CandI battery storage applications, on both a stand-alone basis and modeled with solar PV. This project is utilizing several kW-scale, AC-integrated Znyth (Trademark) battery technology storage systems. The residential and commercial systems will be located at the University of California, San Diego (UCSD) campus. The project team is developing, modeling, and will be testing experimental rate designs and evaluating the impact on customer load profiles; developing control algorithms and demonstrating aggregation of multiple storage units to create virtual power plants that maximize the value of behind-the-meter storage to the utilities; and modeling, simulating, and extrapolating the economic impacts of installed systems and quantifying the benefits to California utilities and ratepayers.	1/13/2016	No	Grid Operations/Market Design	$1,894,866	$1,894,866	$770,190	N/A	$770,190
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-019 Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	Applied Research and Development	This project is researching shallow (20-30 feet deep) and large diameter (2-3 feet diameter) helical coil, ground heat exchanger designs for ground source heat pumps. The project team is developing models, validating them with field data from two home sites and an outdoor lab, identifying optimal designs, and developing modeling methods that can be adapted for use with code compliance tools. The project also produces design specifications that will support future Title 24 eligibility criteria. A design guide is being developed for industry as a training aid, and a position paper is being prepared for the Department of Water Resources' California Geothermal Heat Exchange Well Standards Stakeholder Advisory Group.	3/9/2016	No	Demand-side Management	$1,212,186	$1,212,186	$445,828	N/A	$445,828

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-015 Grid Communication Interface for Smart Electric Vehicle Services Research and Development	$304,177	$0	Suncharge; Verdek;	$465,000	40.6%	Grant	Pre-existing intellectual property identified in agreement EPC-15-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	Andromeda Power, LLC	Ranked # 5
EPC-15-016 A Transformative Flywheel R&D Project	$388,000	$0	Amber Kinetics, Inc.;	$7,500,000	78.9%	Grant	Pre-existing intellectual property identified in agreement EPC-15-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Amber Kinetics, Inc.	Group 2: Ranked # 7
EPC-15-018 Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems	$218,866	$0	Eos Energy Storage, LLC;	$1,436,801	43.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Eos Energy Storage, LLC	Group 2: Ranked # 4
EPC-15-019 Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	$361,292	$0	Frontier Energy, Inc.;	$18,826	1.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Regents of the University of California (University of California, Davis)	Group 1: Ranked # 12

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-015 Grid Communication Interface for Smart Electric Vehicle Services Research and Development	N/A	N/A	Yes; Calif Based Entity	This project enables the harmonization of V2G services, removing the communication barrier between PEVs of different standards and the grid. The communication interface enables Smart Demand Side Management benefits to the ratepayer with the possibility of using PEVs as distributed energy storage and controllable load. Local PEVs can mitigate the renewable over-generation and intermittency by storing renewable energy and delivering it to the grid on demand. The additional smart charging incentive can accelerate PEV adoption to achieve the targeted 1.5 million ZEVs on the road by 2025 and 5 million by 2030. Using PEVs as an energy storage resource can reduce energy demand and stress of the grid, making the load predictable and more manageable.	1g, 2a, 4a, 5b	The project team designed and prototyped two models of Level 2 chargers (ORCA InCISIVE, Strada and Zen) capable of demand response according to the V1G (managed charging) use cases defined by SCE and PG&E. The Andromeda VGI EVSE design includes smart inverter designs to accommodate Rule 21. The EVSEs were installed in the field for durability tests. The project team conducted fast charge/discharge simulation of the PEVs using OpenADR signals and collected performance data. The EVSEs (Level 2 and Level 3) were integrated in a microgrid with 110 kW solar panels to demonstrate the feasibility of the InCISIVE system in mitigating renewable energy overgeneration. The project team is preparing the final report for review and publication.
EPC-15-016 A Transformative Flywheel R&D Project	N/A	N/A	Yes; Calif Based Entity	This project is built on developments that the Amber Kinetics team has made in the areas of improved materials processing for better strength and longer life, as well as improved rotor geometries to maximize energy storage density, thus reducing the cost of the system. The project adds to the energy storage portfolio of options necessary to meet California's storage needs.	1c, 1i, 2a, 4a, 5b	Amber Kinetics completed their commercial readiness tests of more than 25,000 operating hours. They performed safety validation with burst tests to analyze and improve the flywheel containment design. For grid connection using multi-unit arrays, Amber Kinetics developed communication protocols, multi-array connectivity, charge and discharge operations, and control algorithms for coordinating multiple flywheels, which would be needed in a utility scale deployment. They collected flywheel operational data under real-world conditions to prove the design robustness, reliability, round-trip efficiency, and the ability to balance power and control the state of charge. As a result, Amber Kinetics is expanding its business opportunities in Massachusetts and Australia. A final report was published: https://www.energy.ca.gov/2019publications/CEC-500-2019-012/CEC-500-2019-012.pdf
EPC-15-018 Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems	N/A	N/A	None	This project aims to validate the safety, reliability, and performance of a new aqueous, zinc-based battery technology to support customer adoption in behind-the-meter energy storage markets and applications. Behind the meter DER application of energy storage has been identified as a major commercial market for energy storage. Detailed field performance data on the application of energy storage in these behind the meter DER opportunities is critical to the state to open up this market for new and emerging energy storage technologies.	1c, 1i, 2a, 4a, 5b	Eos completed system design and engineering for the units, including developing CandI skid integration schematics including wiring diagrams; CandI battery management system software; the design for the residential battery rack; assembly of residential battery management system panels; the assembly of the inverter for residential standalone system; and the assembly of the CandI master controls and inverter. Eos has begun the manufacturing and assembly of CandI and residential skids for installation at UCSD, as well as the CandI battery management system cabinets. All components will ship to California for integration in early 2019, followed by installation and commissioning at UCSD.
EPC-15-019 Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	N/A	N/A	None	The project spurs the market for high efficiency GCHPs by evaluating and testing an innovative method to reduce the cost of GHE, whose cost has been a barrier to more GCHP installations. The current method of drilling GHE bores requires costly, specialized deep drilling rigs, that often must be transported from out of state. Instead, by using common, locally available drilling equipment for shallow bores, GHE bore drilling can be done at lower cost. In addition, this technology will be made ready for commercialization by developing modeling tools needed to properly design, size, and evaluate energy savings and to facilitate use with California Title 24 standards compliance tools.	1e, 1f, 1h	The team is installing instrumentation at the outdoor lab site. The data from this site will be used to develop a model to study the optimization of the ground heat exchanger design. The team is developing a test plan to coordinate experiments to validate its model. The validated model will ultimately be used to develop relationships describing the performance of shallow-bore, helical ground heat exchangers for use in EnergyPlus.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-020 Intelligent HVAC Controls for Low Income Households: A Low Cost Non-connected Device that Understands Consumer Preferences and Performs Adaptive Optimization	Applied Research and Development	This project is developing a low-cost smart thermostat with a simplified user interface. It is being tested in low-income and senior housing, but can be readily adapted to other building sectors, including small commercial. The smart thermostat will track user preferences and manage indoor conditions to optimize energy use. Internet connectivity is not required. By automatically optimizing thermostat settings, this project determines if smart thermostats can be a cost-effective method to address HVAC energy use in sectors where it does not make sense for building owner or tenant to make HVAC system upgrades.	2/10/2016	No	Demand-side Management	$2,705,759	$2,705,759	$694,957	N/A	$694,957
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-021 Mobile Efficiency for Plug Load Devices	Applied Research and Development	This project designed a methodology guideline for plug load manufacturers to use in developing energy efficient plug load devices. In developing the guideline, the recipient will evaluate mobile design practices, hardware components, and power management software kernels to prove their effectiveness. The results were used to develop the first virtual prototypes and reference designs for energy optimized hardware and software that can guide plug load device manufacturers to reach mobile energy efficiency levels. Manufacturers will use these reference designs to develop and mass deploy energy efficient plug load devices into the marketplace. When these reference designs are used there should be a reduction of energy consumption of residential and commercial plug load devices, such as set-top boxes, TVs, computers, and game consoles. The project defined and introduce a widely accepted industry standard through the Institute of Electrical and Electronics Engineers (IEEE) to support the newly developed unified design methodology and secure its long-term adoption and further evolution.	3/9/2016	No	Demand-side Management	$1,996,999	$1,996,999	$1,797,826	N/A	$1,797,826
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-022 Power Management User Interface	Applied Research and Development	This project seeks to reduce energy consumption in personal computers by improving how users employ existing power management capabilities. Although all computers have the capacity to enter low-power modes such as sleep, and can be shut down when not in use, this potential for energy savings has not been realized in the majority of desktop computers. These computers remain on at full power when they are not used. The problem is one of user behavior. The project uses a software solution to change user behavior by changing the tool they are using. This approach is firmly based in behavior theory and human-computer interaction research, which have long demonstrated that the interface of a device can change users' behavior.	3/9/2016	No	Demand-side Management	$785,124	$785,124	$611,153	N/A	$611,153
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-023 Gaming System Energy Efficiency without Performance Compromises	Applied Research and Development	This project provided a detailed market segmentation and baseline energy demand assessment of the gaming market, including development of measurement and benchmarking protocols for gaming software and hardware. Top-selling gaming PCs and games are then cross-benchmarked and retrofitted to achieve maximum energy savings beyond what commercialized products currently can attain.	3/9/2016	No	Demand-side Management	$1,386,530	$1,386,530	$1,386,530	N/A	$1,386,530

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EPC-15-020 Intelligent HVAC Controls for Low Income Households: A Low Cost Non-connected Device that Understands Consumer Preferences and Performs Adaptive Optimization	$903,766	$0	Electric Power Research Institute, Inc.;	$427,072	13.6%	Grant	Pre-existing intellectual property identified in agreement EPC-15-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 11
EPC-15-021 Mobile Efficiency for Plug Load Devices	$136,800	$0	AGGIOS, Inc.; Freescale; International Rectifier; Keysight; Mentor Graphics; Synopsys;	$6,030,450	75.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	AGGIOS, Inc.	Group 1: Ranked # 1
EPC-15-022 Power Management User Interface	$300,159	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	The Regents of the University of California, Irvine	Group 1: Ranked # 6
EPC-15-023 Gaming System Energy Efficiency without Performance Compromises	$658,250	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 5

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EPC-15-020 Intelligent HVAC Controls for Low Income Households: A Low Cost Non-connected Device that Understands Consumer Preferences and Performs Adaptive Optimization	N/A	N/A	Yes; Calif Based Entity	This project bridges a technology connectivity gap in low-income and senior communities. Current smart thermostats are expensive, and a lack of broadband internet access makes these devices a bad fit for the low-income market. Developing a low-cost, internet-independent device creates opportunities to expand smart grid infrastructure and capture energy savings associated with automated controls in hard to reach building sectors.	1f, 1g, 1h, 3a, 4a	The team recently completed hardware design for the prototype thermostat. Application development including user experience is ongoing and will undergo early stage testing in December 2018. Full scale pilot testing will begin in early 2019 when benefits will begin to be quantified.
EPC-15-021 Mobile Efficiency for Plug Load Devices	N/A	N/A	Yes; Micro Business, Calif Based Entity	This project advanced a methodology guideline to help plug load manufactures develop energy efficient plug load devices. The recipient is conducted detailed technical analysis on new software, hardware and power management design and verification methodology, conducted tests on virtual prototypes, verified energy savings, and developed reference designs, in the form of design guidelines. This information is available to the plug load device manufacturers and their suppliers to help accelerate the adoption of mobile efficiency practices across multiple product categories in the shortest time and the lowest costs. As many current plug load devices in the market lack any power management capabilities, similar to those in smart phones, this project paved the way for plug load manufacturers to advance those capabilities into other plug load devices.	1f, 1h	The project is complete and the final report will be published January 2019. The project team completed the energy modeling of the power management system and its use. The team completed an application to IEEE to create standardized energy efficient specifications for plug load devices. This process may take up to two years. The standardization efforts are a key factor in enabling wider adoption of efficiency reference designs to allow a standard, comparable assessment of energy use of various plug load devices. Increased use of reference designs and programming of more efficient standby modes has the potential to reduce annual energy consumption by 20-50%.
EPC-15-022 Power Management User Interface	N/A	N/A	Yes; Calif Based Entity	The Recipient will develop and test a new user interface designed to facilitate and encourage greater utilization of low-power modes by computer users. The interface design will incorporate lessons from the fields of human-computer interaction and behavior theory. The field test will provide data that will improve understanding of user behavior toward computer power management.	1f, 1h	The recipient is preparing the final report. The team has completed the Software Development Report for the Power Management User Interface Study and has produced a fully functional software that is ready and an improvement over the initial prototype. The recipient has conducted field tests of the software on university staff desktops with more than 300 staff participants. Preliminary results indicate savings of over 50 percent per computer or about 139 kWh per year. The baseline computers used were more efficient than originally estimated, and although the percentage energy savings was high (as high as 61%), the total energy savings (net kWh) was lower than the originally estimated.
EPC-15-023 Gaming System Energy Efficiency without Performance Compromises	N/A	N/A	Yes; Calif Based Entity	This project advanced the design of energy efficient of video gaming computers and consoles by demonstrating system designs that are significantly more efficient than current market offerings. The research results may influence component and integrated system manufacturers and game developers to bring more energy efficient video game computers and consoles into the market without sacrificing the gaming experience. The project identified potential opportunities for codes and standards improvements and/or utility incentives. California ratepayers may benefit by having lower energy use and costs associated with their gaming systems without compromising their video game choices and experience.	1f, 1h	This project is completed and the final report will be published in January 2019. The team conducted energy use testing and analysis of video game computers and consoles, including testing the same game on various devices. The team found no relationship between energy use and device type. There is no regulation affecting this industry yet, so the team recommends establishing voluntary standards similar to Energy Star. The standards would cover: energy ratings, power component rankings, and energy game ratings. The information from this project is available and has been shared to the California Energy Commission to influence codes and standards for computers and video game consoles, and encourage manufacturers to reduce the energy use of these devices.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-024 Efficient and ZNE-Ready Plug Loads	Applied Research and Development	This project researches and develops new technologies and strategies to eliminate or significantly reduce energy use in standby mode by redesigning the power supply for plug load devices. This project also develops and demonstrates strategies to remove plug load devices from grid AC power by redesigning these devices to use DC power from photovoltaic power sources.	3/9/2016	No	Demand-side Management	$1,600,000	$1,600,000	$941,352	N/A	$941,352
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-025 Plug Load Reduction App: RYPL	Applied Research and Development	This project researches methods to reduce home idle loads by utilizing smart meter analytics, an engaging smart phone app, a new online crowd-sourced database of miscellaneous electric loads, and an online efficient product marketplace to educate California residents about the idle load of their home and ways to reduce it. The system is to be piloted within all three electric investor owned utility territories and measure actual energy savings through smart meter data.	3/9/2016	No	Demand-side Management	$884,100	$884,100	$824,984	N/A	$824,984
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-026 Unlocking Plug Load Energy Savings through Energy Reporting	Applied Research and Development	This project is developing an interoperable protocol that can be implemented in all plug-load devices, unhampered by proprietary restrictions which will implement energy reporting to enable plug-load devices to transmit operating information - such as identity, power consumption, and functional state - through a communications network to a central entity. After a communication infrastructure is established for plug-load devices, the data flow can be reversed to send control signals to individual devices. The central management system that this project will demonstrate is well positioned to provide comprehensive control over diverse plug-load devices.	3/9/2016	No	Demand-side Management	$1,630,699	$1,630,699	$1,048,910	N/A	$1,048,910
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-027 Electric Plug Load Savings Potential of Commercial Foodservice Equipment	Applied Research and Development	This project assesses the reduction potential of electric commercial plug load foodservice equipment at five different commercial kitchens and demonstrates the potential for reduced energy consumption through the use of pre-commercial appliance designs and control technologies.	4/13/2016	No	Demand-side Management	$937,469	$937,469	$347,278	N/A	$347,278
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-028 Real World Electrification Options of Energy Services and Environmental Justice (EJ) Considerations	Applied Research and Development	The research team is conducting a statewide assessment - at the zip code level - of the potential for electrification (e.g., use of electricity for space heating) to generate benefits to customer cost savings, statewide economy, climate, and air quality. The assessment will feed a comprehensive climate and energy model and a subsequent air quality analysis that will help determine public health benefits, with a focus on the South Coast and the San Joaquin Valley air basins.	4/13/2016	No	Generation	$799,444	$799,444	$367,636	N/A	$367,636

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EPC-15-024 Efficient and ZNE-Ready Plug Loads	$634,531	$0	Lawrence Berkeley National Laboratory; EMerge Alliance; Power Integrations; Delta Electronics;	$495,000	23.6%	Grant	Pre-existing intellectual property identified in agreement EPC-15-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 2
EPC-15-025 Plug Load Reduction App: RYPL	$634,531	$0	Home Energy Analytics; Enervee Corporation;	$350,000	28.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Home Energy Analytics	Group 1: Ranked # 2
EPC-15-026 Unlocking Plug Load Energy Savings through Energy Reporting	$123,700	$0	Lawrence Berkeley National Laboratory; Energy Solutions; The Watt Stopper;	$494,318	23.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1
EPC-15-027 Electric Plug Load Savings Potential of Commercial Foodservice Equipment	$392,763	$0	Fisher-Nickel, Inc.; Pacific Gas and Electric Company; NAFEM; Dalla Corte; Nuova Simonelli; Hatco;	$202,450	17.8%	Grant	Pre-existing intellectual property identified in agreement EPC-15-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Fisher-Nickel, Inc.	Group 1: Ranked # 4
EPC-15-028 Real World Electrification Options of Energy Services and Environmental Justice (EJ) Considerations	$234,351	$0	Electric Power Research Institute, Inc.; South Coast Air Quality Management District;	$759,213	48.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1

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EPC-15-024 Efficient and ZNE-Ready Plug Loads	N/A	N/A	Yes; Calif Based Entity	Standby power use is the electricity consumed by almost every electrical consumer device plugged in to an electrical outlet. Standby power is responsible for roughly 5% of California's residential electricity use. This project will develop an innovative family of zero-standby technology solutions and will enable the next generation of electrical devices to draw zero standby power while providing the full range of functionality that are desired by consumers.	1f, 1h, 4a	The project is on track and the draft report is expected in March 2019. The researchers are reviewing technologies for energy harvesting and energy storage in order to identify those most suitable for pairing with a power supply. They are also working on identifying energy efficiency technologies to integrate into selected plug loads that take into account human behaviors and device functionalities. CPR #2 was conducted in June 2018. An abstract paper by Alan Meier, the principal investigator of the project on "Zero Standby Power Supply" was presented at 2018 ACEEE summer study as part of the knowledge transfer activities.
EPC-15-025 Plug Load Reduction App: RYPL	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity, Woman Own	Idle load is a new concept to most residential energy users and includes appliances and equipment in the off or standby mode but still drawing power. The recipient has developed an innovative smart phone app called Dr. Power which provides residents with information about their idle loads, provides ideas and a plan to reduce the idle loads, and correlates any energy saving actions with smart meter data. This simple to use app tests the theory that if accurate information about energy use is provided to consumers, they will be more likely to engage and take action. This technology has the potential to advance consumer knowledge and overcome barriers to reducing idle loads that could hinder the State's goal of doubling energy efficiency by 2030 and/or achieving zero net energy buildings in the future.	1f, 1h	The recipient released minor updates to both the Android and iOS versions of Dr. Power. The project currently has 529 Dr. Power users, adding 25 users between September 2019 and November 2019. Most users are in the PG&E service area and the recipient is working with SDG&E and SCE to add several thousand more from their service area. The recipient is focusing on increasing outreach and using methods that will have long term sustainability and increase the user base even after the end of the agreement. Software enhancement is currently in progress to allow Dr. Power to deploy to more homes.
EPC-15-026 Unlocking Plug Load Energy Savings through Energy Reporting	N/A	N/A	Yes; Calif Based Entity	Building operators and end users do not have a clear or accurate tally of the plug load devices in their buildings, how much energy is used or how they could be better controlled to save energy. The recipient is developing inexpensive, proprietary-free technologies that can acquire energy use data for networked plug load devices and make them available to building owners. The technologies will be able to identify abnormally large plug load energy use and enable building owners to react to its energy use. The technology could be incorporated directly into California's building codes and other energy efficiency standards.	1f, 1h, 3a, 4a	The project team has finished remote harvesting of energy usage data from all ten devices being tested. Devices tested include those for a water heater, light switch, Macbook, and a vehicle charger. The project team has begun collaboration with the Energy Commission's Appliance Standards and Building Codes teams to discuss opportunities to develop code change proposals.
EPC-15-027 Electric Plug Load Savings Potential of Commercial Foodservice Equipment	N/A	N/A	Yes; Calif Based Entity	The project advancement is to bridge the knowledge gap and support the accelerated adoption of advanced appliances and controls by better understanding operator behavior and operational changes that can be made to successfully use new lower energy appliances. The results of this effort will be used to develop real world case studies of successful implementation of next generation plug load appliances, and provide training to food service operators to maximize energy reduction potential for food service equipment. In addition to food service operators, the research results will assist equipment manufacturers in further product development of energy efficient food service equipment and help justify development of utility incentives for purchasing and installing energy efficient foodservice equipment.	1e, 1f, 1h	The project currently has 19 different sites in California and is continuing to add and grow the existing data base of test sites. The recipient has collected baseline data and installed new equipment at most of these restaurants. Plug load meters were installed at each of the test sites to determine baseline electrical consumption. Depending on logistics and site flexibility, between two weeks and three months of baseline data was collected. The field data thus far showed that commercial foodservice plug load equipment has a wide range of energy intensity, based on the operation type and hours. Cumulative energy savings for all plug load equipment can be substantial. The appliance with the highest average daily energy use, the conveyor toaster, used more than 20 times the energy on average than the appliance with the lowest average daily energy use, the soup warmer.
EPC-15-028 Real World Electrification Options of Energy Services and Environmental Justice (EJ) Considerations	N/A	N/A	None	The analysis of health and air quality benefits alongside costs of electrification under this agreement is forming the basis for new cost-benefit metrics that can be used to assess the economic viability of breakthrough technologies. Cost-benefit analyses of this sort can be used to make evidence-based decisions regarding technology financing and deployment.	1f, 1h, 2a, 4a, 4b	The research team has developed draft long-term electrification scenarios for the residential, commercial, and transportation sectors. These scenarios have been translated to emissions of conventional air pollutants at relatively fine geographical resolution and with the necessary temporal resolution for sophisticated photochemical modeling. Results so far suggest substantial improvements in air quality. The research team is now in the process of preparing parts of the final report for the review by the members of the technical advisory committee.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-029 Distributed Generation Environmental Planner	Applied Research and Development	This project developed a tool to identify environmentally preferred areas for distributed solar generation (DG). The project demonstrated how disparate spatial information, such as solar capacity, environmental data, and utility infrastructure, can be combined in a site screening tool for effective local DG planning. The project aimed to expand energy planning tools at the local level by leveraging the ongoing development of a statewide planning tools. The existing statewide tool (prototype currently called the "RE Infrastructure Planning Assistant") focuses primarily on environmental screening for utility scale renewable energy development. This project adds more detailed energy and economic information appropriate for distribution-scale solar siting and most importantly incorporates distributed generation into the prototype interactive mapping tool and tests it in Lancaster, California.	4/13/2016	No	Generation	$199,976	$199,976	$199,536	N/A	$199,536
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-030** San Diego Regional Energy Innovation Cluster	Applied Research and Development	This project has developed a collaboration of clean energy organizations in the San Diego Region to provide and coordinate key services, resources, and infrastructure needed by entrepreneurs and researchers in the region. The project aims to accelerate the successful market entry of energy innovations that can benefit electric ratepayers. This project is also working with businesses, local jurisdictions and other organizations in the region to connect emerging technologies to region specific-needs.	4/13/2016	No	Demand-side Management	$3,000,000	$3,000,000	$1,192,051	N/A	$1,192,051
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-030** San Diego Regional Energy Innovation Cluster	Market Facilitation	This project has developed a collaboration of clean energy organizations in the San Diego Region to provide and coordinate key services, resources, and infrastructure needed by entrepreneurs and researchers in the region. The project aims to accelerate the successful market entry of energy innovations that can benefit electric ratepayers. This project is also working with businesses, local jurisdictions and other organizations in the region to connect emerging technologies to region specific-needs.	4/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-031 Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response	Applied Research and Development	This agreement develops integrated plug load control strategies for different spaces within multiple types of commercial buildings. The project implements a flexible energy management system (FEMS) to demonstrate the integrated control strategies for plug loads at pilot sites. This includes the installation of smart power outlets and integration of various plug load control strategies with building energy management and/or lighting control systems. The project demonstrates and measures the degree of effectiveness of the flexible control strategies developed for integrally managing operation of plug loads to achieve energy efficiency and demand reductions.	4/13/2016	No	Demand-side Management	$1,050,022	$1,050,022	$133,542	N/A	$133,542
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-032** Bay Area Regional Energy Innovation Cluster	Applied Research and Development	This project established the Bay Area Regional Energy Innovation Cluster by expanding the Cyclotron Road program to provide commercialization support services to Bay Area entrepreneurs developing breakthrough materials and hardware devices in energy efficiency, energy storage, distribution, grid management, and power generation. Cyclotron Road provides entrepreneurs access to world-class laboratory facilities, and key services, such as business model development, customer discovery, and intellectual property protection to enable energy entrepreneurs in the Bay Area region.	4/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$919,548	N/A	$919,548

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-029 Distributed Generation Environmental Planner	$44,350	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Black & Veatch Corporation	Group 5: Ranked # 1
EPC-15-030** San Diego Regional Energy Innovation Cluster	$880,681	$0	Cleantech San Diego Association; CONNECT;	$3,097,934	38.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Cleantech San Diego Association	Group 3: Ranked # 1
EPC-15-030** San Diego Regional Energy Innovation Cluster	$0	$0	Cleantech San Diego Association; CONNECT;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Cleantech San Diego Association	Group 3: Ranked # 1
EPC-15-031 Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response	$366,082	$0	Electric Power Research Institute, Inc.; San Diego Gas and Electric Company; To Be Determined; Enmetrics Systems; Ibis Networks; SkyCentrics; TBD - Technical Writer;	$335,120	24.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 2
EPC-15-032** Bay Area Regional Energy Innovation Cluster	$282,411	$0	Autodesk, Inc.; Lawrence Berkeley National Laboratory; Activation Energy, Inc.; DLA Piper LLP;	$9,000,000	64.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Activation Energy, Inc.	Group 4: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-029 Distributed Generation Environmental Planner	N/A	N/A	Yes; Calif Based Entity	This agreement created a prototype, public tool (http://dg-solar.org/) that enables DG PV site selection by providing users both environmental and engineering geospatial data. Having proven the concept in Lancaster, CA, the tool may be expanded to other areas of California that have similar availability of input data. Making information more comprehensive and accessible at the DG level will improve market functioning, while also enabling better DG infrastructure planning that incorporates environmental conservation.	2a, 4f	This project was completed in 2018. The final report is available online at http://www.energy.ca.gov/2018publications/CEC-500-2018-010/CEC-500-2018-010.pdf. The research team designed the technical specifications of the planning tool, developed the web-based application, and compiled and processed spatial data. The tool combines solar resource, environmental sensitivity, cost, and interconnection spatial data layers in a single GIS application. The format of the tool allows user-entered values for a variety of screening parameters that may be of interest to developers, local planners, and government officials. The tool returns maps and lists of parcels that match the user-entered criteria and then generates reports. The completed tool went live online in 2017. The TAC member from sPower is interested in using the tool to guide future solar development in Lancaster.
EPC-15-030** San Diego Regional Energy Innovation Cluster	N/A	N/A	None	This project is advancing the goals of SB 350 (2015) by accelerating the commercialization of new clean energy technologies that can enable the integration of high-penetrations of renewables and distributed energy resources. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2018 the San Diego Regional Energy Innovation Network (SDREIN) expanded the number of supported companies to over 25. These companies are developing innovations in areas such as storage technology, EV smart charging, and DER aggregation. Collectively, these companies have gone on to attract over $15 million in private follow-on funding and over $9 million in public follow-on funding since being accepted into the program. The SDREIN was also awarded a $750,000 grant from the U.S. Economic Development Administration's i6 Challenge. This additional funding will be used to expand SDREIN services into the Inland Empire region.
EPC-15-030** San Diego Regional Energy Innovation Cluster	N/A	N/A	None	This project is advancing the goals of SB 350 (2015) by accelerating the commercialization of new clean energy technologies that can enable the integration of high-penetrations of renewables and distributed energy resources. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2018 the San Diego Regional Energy Innovation Network (SDREIN) expanded the number of supported companies to over 25. These companies are developing innovations in areas such as storage technology, EV smart charging, and DER aggregation. Collectively, these companies have gone on to attract over $15 million in private follow-on funding and over $9 million in public follow-on funding since being accepted into the program. The SDREIN was also awarded a $750,000 grant from the U.S. Economic Development Administration's i6 Challenge. This additional funding will be used to expand SDREIN services into the Inland Empire region.
EPC-15-031 Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response	N/A	N/A	Yes; Calif Based Entity	In order to reduce plug load energy use and increase the energy efficiency of buildings, this project advances flexible energy management systems coupled with smart power outlet technology to control plug load use. The project will also enhance integrated strategies for operating different plug load types to achieve energy efficiency and demand response. The results of this project can potentially reduce electricity use in commercial buildings, particularly during low-occupancy times and in user-assigned spaces, thereby achieving lower electricity costs for the ratepayer.	1e, 1f, 1h	The project team is evaluating the plug load controls at both their Stanford laboratory setting and AP+ Design architecture design test sites. The controls were installed at both sites in 2017. Analysis will be conducted on the 1+ year of data collected to determine effectiveness in achieving energy efficiency and demand reductions.
EPC-15-032** Bay Area Regional Energy Innovation Cluster	N/A	N/A	Yes; Calif Based Entity	This project will help advance the goals of Senate Bill 350 (De Leon, 2015) by accelerating the commercialization of clean energy technologies, including energy efficiency, demand response, renewable generation, energy storage, and smart-grid integration. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2018, Cyclotron Road accepted its fourth cohort of fellows into its program. This latest round of entrepreneurs is developing innovations in areas such as long-duration energy storage, enhanced geothermal systems, and biomass torrefaction. The fellows will spend the next two years working on bringing their technologies closer to market, and have already attracted additional investments from ARPA-E and Breakthrough Energy Ventures. In addition to supporting the latest cohort of fellows, the project team expanded their publicly available resource library to include an online video series on techno-economic modeling. The resource library is available at http://www.cyclotronroad.org/resource-lab/. In 2019, Cyclotron Road will bring on a fifth cohort of entrepreneurial scientists and engineers as it continues to support advancements in clean energy hardware technologies

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-032** Bay Area Regional Energy Innovation Cluster	Market Facilitation	This project established the Bay Area Regional Energy Innovation Cluster by expanding the Cyclotron Road program to provide commercialization support services to Bay Area entrepreneurs developing breakthrough materials and hardware devices in energy efficiency, energy storage, distribution, grid management, and power generation. Cyclotron Road provides entrepreneurs access to world-class laboratory facilities, and key services, such as business model development, customer discovery, and intellectual property protection to enable energy entrepreneurs in the Bay Area region.	4/13/2016	No	Demand-side Management	$2,980,000	$2,980,000	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-033 Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC	Applied Research and Development	Several technologies that deliver HVAC services and energy savings are being field tested at several schools in California. The identified technologies in this study include heat recovery ventilators, air economizers, demand control ventilation, displacement ventilation, high performance filtration, and learning thermostats. These are advancements that are over and above the technologies typically used in California schools, and can greatly improve the energy efficiency of providing heating, cooling, and ventilation in classrooms.	4/13/2016	No	Distribution	$1,500,000	$1,500,000	$882,162	N/A	$882,162
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-035 Clarifying and Quantifying Current and Near-Term Groundwater Pumping Energy Use and Costs in California to Improve Energy and Water Systems Reliability	Applied Research and Development	The project is quantifying current statewide energy use and costs attributable to groundwater pumping and developing near-term projections of energy use and statewide costs. The projections will factor in groundwater demand, groundwater levels, climate change scenarios, energy prices, and obstacles to implementing energy-efficient pumping and groundwater conservation measures. By expanding knowledge of the relationship between groundwater pumping and energy use, the project will enhance the ability of the State of California and irrigation and drinking water districts to coordinate water and energy resources planning. In addition, the project is providing key insights on how to improve groundwater use and pumping efficiency.	4/13/2016	No	Demand-side Management	$625,000	$625,000	$530,408	N/A	$530,408
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-036 Probabilistic Seasonal and Decadal Forecasts for the Electricity System Using Linear Inverse Modeling	Applied Research and Development	The research team developed and tested new forecast methods for temperature and humidity and extensive testing is taking place. The forecasts will be provided in the format used by energy planners and managers. The researchers are exploring the forecasting utility of parameters such as sea surface temperatures in the middle of the Pacific Ocean that can influence summer conditions in California months in advance. The decadal forecasts will be done using forecasts of large-scale predictor variables of climate from different research centers downscaled to the California region.	4/13/2016	No	Grid Operations/Market Design	$400,000	$400,000	$277,623	N/A	$277,623
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-037 Smart Ventilation for Advanced California Homes	Applied Research and Development	This project develops approaches and tools to enable smart ventilation techniques suitable for new and existing advanced and ZNE homes. Smart ventilation systems use information about current thermal, occupancy, system, and air quality conditions to optimize performance of ventilation-related equipment.	4/13/2016	No	Distribution	$1,500,000	$1,500,000	$741,240	N/A	$741,240

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EPC-15-032** Bay Area Regional Energy Innovation Cluster	$0	$0	Autodesk, Inc.; Lawrence Berkeley National Laboratory; Activation Energy, Inc.; DLA Piper LLP;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Activation Energy, Inc.	Group 4: Ranked # 1
EPC-15-033 Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC	$439,287	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Regents of the University of California, Davis	Group 1: Ranked # 2
EPC-15-035 Clarifying and Quantifying Current and Near-Term Groundwater Pumping Energy Use and Costs in California to Improve Energy and Water Systems Reliability	$260,000	$0	Michael Hanneman;	$22,550	3.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Lawrence Berkeley National Laboratory	Group 7: Ranked # 1
EPC-15-036 Probabilistic Seasonal and Decadal Forecasts for the Electricity System Using Linear Inverse Modeling	$26,898	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Eagle Rock Analytics	Group 10: Ranked # 1
EPC-15-037 Smart Ventilation for Advanced California Homes	$649,037	$0	Lawrence Berkeley National Laboratory; United States Department of Energy; Aereco S.A.;	$1,300,000	46.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-032** Bay Area Regional Energy Innovation Cluster	N/A	N/A	Yes; Calif Based Entity	This project will help advance the goals of Senate Bill 350 (De Leon, 2015) by accelerating the commercialization of clean energy technologies, including energy efficiency, demand response, renewable generation, energy storage, and smart-grid integration. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2018, Cyclotron Road accepted its fourth cohort of fellows into its program. This latest round of entrepreneurs is developing innovations in areas such as long-duration energy storage, enhanced geothermal systems, and biomass torrefaction. The fellows will spend the next two years working on bringing their technologies closer to market, and have already attracted additional investments from ARPA-E and Breakthrough Energy Ventures. In addition to supporting the latest cohort of fellows, the project team expanded their publicly available resource library to include an online video series on techno-economic modeling. The resource library is available at http://www.cyclotronroad.org/resource-lab/. In 2019, Cyclotron Road will bring on a fifth cohort of entrepreneurial scientists and engineers as it continues to support advancements in clean energy hardware technologies
EPC-15-033 Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC	N/A	N/A	Yes; Calif Based Entity	The agreement provides information on indoor air quality and energy usage in classrooms with current HVAC systems throughout different parts of California. The project then evaluates next generation HVAC system retrofits with regards to energy efficiency and indoor air quality performance. The results will enable energy savings without impacting indoor air quality in classrooms. The study is the first large field study to examine the energy efficiency upgrade and indoor air quality impacts after the recent energy retrofit.	4b, 5d	The research team collected indoor air quality monitoring, ventilation, and energy usage data from 104 classrooms in 11 schools that use current HVAC systems. The characteristics of the classrooms and schools include locations, district sizes, grades, free/reduced lunch percentage, and equipment types. A teacher survey on usage of the HVAC system in classrooms was also completed with an excellent response rate. The monitoring data provides the baseline for energy performance and indoor air quality condition for the current HVAC system. The research team has installed and commissioned two next generation HVAC systems on two demonstration schools. The data collection process is ongoing until the end of 2018.
EPC-15-035 Clarifying and Quantifying Current and Near-Term Groundwater Pumping Energy Use and Costs in California to Improve Energy and Water Systems Reliability	N/A	N/A	Yes; Calif Based Entity	This study is quantifying current and near-term statewide energy use and costs due to groundwater pumping. Previous estimates of energy use for groundwater pumping likely underestimated the amount of energy used because of a lack of good information on actual groundwater use. Due to recent regulatory changes, the availability of information on groundwater use has increased significantly. This information, combined high resolution modeling of hydrologic and climate change effects will allow the researchers to produce more accurate estimates of current and future energy used for groundwater pumping. Benefits from this study will enable entities, such as investor owned utilities, water agencies and others to increase the efficiency of the energy used in the water sector, inform Demand Side management strategies, and decrease greenhouse gas emissions.	1f, 2a, 4c	This project is in progress and is continuing to collect data on groundwater pumping and electricity use. A technical advisory committee meeting was held in November, 2018 to identify additional data sources. Data collected for this project so far has been limited with significant gaps and inconsistencies. Therefore, recent efforts have focused on addressing these deficiencies while continuing to collect data from agricultural and other large scale groundwater users. Hydrologic modeling of groundwater changes in the state's Central Valley to supplement data gaps and allow simulations of future groundwater and associated energy demand continues. Due to these data collection difficulties, delivery of technical deliverables due in late 2018 have been delayed. Significant effort will need to be complete the project by the contract end date in June of this year.
EPC-15-036 Probabilistic Seasonal and Decadal Forecasts for the Electricity System Using Linear Inverse Modeling	N/A	N/A	Yes; Calif Based Entity	This project is unique in its use of sea surface temperatures to create a probabilistic forecast of long-term weather conditions in California. The project aims to determine, for example, the likelihood of California experiencing consecutive days above 105 degrees F in a given year.	5c	The research team is on track to deliver an operational seasonal forecast model based on Linear Inverse Modeling in early 2019. The team has begun translating the underlying code for compatibility with Cal-Adapt so that it is amenable to integration with this publicly available, interactive, and easy-to-use platform. Additionally, based on input from utilities engaged through the Technical Advisory Committee, the research team has elicited the variables and types of predictions that they are most interested in, namely seasonal temperature predictions (done), changing shape of diurnal (hourly) temperature curves, and winter season hydrology. Accordingly, the research team is exploring the ability of their model to further resolve seasonal temperature predictions in a manner that sheds light on the latter two considerations.
EPC-15-037 Smart Ventilation for Advanced California Homes	N/A	N/A	Yes; Calif Based Entity	This work builds on efforts of the past decade that have facilitated dynamic ventilation approaches. The project uses informed simulation approaches to determine how energy, IAQ, demand, and comfort can be optimized using smart ventilation. The results from the project will help consumers identify effective smart ventilation strategies and provide important information that advises the Energy Commission in development of ventilation standards.	4b, 5d	The research team completed the literature review of smart ventilation, resulting in a few journal publications. The team also developed a guideline for indoor air quality (IAQ) metrics. These metrics have now been used in a Department of Energy project in the development of a home IAQ scoring system. The key technical work for this project is to develop an integrated energy simulation model that includes smart ventilation technology. The simulation work is expected to start in 2019. The team also developed a range of optimized control algorithms for various home ventilation scenarios based on occupancy, timers, and weather conditions.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-038** BlueTechValley Innovation Cluster	Applied Research and Development	This project expands access for clean energy entrepreneurs to a region-wide energy-water-food nexus incubator and commercialization services in California's Central Valley and North State regions. The Central Valley Energy Innovation Cluster (a.k.a. BlueTech Valley Energy Cluster) provides entrepreneurs with a variety of services, including technology evaluation, proof-of-concept validation and advisory support as well as opportunities to connect with investors, industry leaders and potential customers.	4/13/2016	No	Demand-side Management	$3,000,000	$3,000,000	$558,551	N/A	$558,551
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-038** BlueTechValley Innovation Cluster	Market Facilitation	This project expands access for clean energy entrepreneurs to a region-wide energy-water-food nexus incubator and commercialization services in California's Central Valley and North State regions. The Central Valley Energy Innovation Cluster (a.k.a. BlueTech Valley Energy Cluster) provides entrepreneurs with a variety of services, including technology evaluation, proof-of-concept validation and advisory support as well as opportunities to connect with investors, industry leaders and potential customers.	4/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-039 Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle	Applied Research and Development	This project installs soil and meteorological sensors at sites with solar installations and in adjacent undisturbed areas to make direct comparisons on the gains or losses of carbon, changes in microclimate and hydrology, changes in dust generation or capture, aiming to predict long term soil and GHG emissions changes based on geochemical modeling. The project addresses the question of whether land alteration and modification during the construction and use of solar installations has a measurable impact on the soil carbon balance, and ultimately on the net carbon savings that solar installations provide during their lifetime.	4/13/2016	No	Generation	$499,181	$499,181	$31,720	N/A	$31,720
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-040 Assessing California's Mitigation Guidelines for Burrowing Owls Impacted by Renewable Energy	Applied Research and Development	The project studies and tests the consequences of both passive and active relocation methods for burrowing owls (a California Species of Special Concern), and fills an existing need for robust scientific data on the relative effectiveness of relocation as a conservation method. Secondary goals are to provide data on owl movements and habitat use that can inform collision risk models and site selection decisions for renewable energy-generating facilities. The project team has fit more than 50 owls with GPS tracking devices and dividing them into three study groups--active translocation, passive relocation, and a control group. Frequent site visits are providing information on mortality rates and reproductive output.	5/17/2016	No	Generation	$598,671	$598,671	$335,856	N/A	$335,856

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-038** BlueTechValley Innovation Cluster	$718,347	$0	Schatz Energy Research Center; California State University, Fresno Foundation; Los Angeles Cleantech Incubator; Kern Economic Development Corporation; Child Family Institute for Innovation and Entrepreneurship - UC Davis;	$2,655,684	34.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	California State University, Fresno Foundation	Group 1: Ranked # 1
EPC-15-038** BlueTechValley Innovation Cluster	$0	$0	Schatz Energy Research Center; California State University, Fresno Foundation; Los Angeles Cleantech Incubator; Kern Economic Development Corporation; Child Family Institute for Innovation and Entrepreneurship - UC Davis;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	California State University, Fresno Foundation	Group 1: Ranked # 1
EPC-15-039 Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle	$80,312	$0	SunPower Corporation;	$72,000	12.6%	Grant	Pre-existing intellectual property identified in agreement EPC-15-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Berkeley	Group 4: Ranked # 1
EPC-15-040 Assessing California's Mitigation Guidelines for Burrowing Owls Impacted by Renewable Energy	$54,425	$0	United States Department Fish and Wildlife Service; Zoological Society of San Diego dba San Diego Zoo Global; Western Riverside County Regional Conservation Authority; Coachella Valley Conservation Commission;	$602,936	50.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Zoological Society of San Diego dba San Diego Zoo Global	Group 6: Ranked # 2

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-038** BlueTechValley Innovation Cluster	N/A	N/A	Yes; Calif Based Entity	This project will help lead to technology advancements by providing and coordinating key services, assistance, resources, and infrastructure needed by entrepreneurs and researchers to create and develop advanced energy technologies that will help the state meet the targets set by Senate Bill 350 to increase both renewable electricity generation and energy efficiency to 50 percent by 2030.	2a, 3e	As of 2018, BlueTechValley (BTV) has accepted and supported 113 companies into their program (57 companies in 2018) and these companies have received $13.9 million in additional private capital funding and $600,000 in additional public funding in 2018, with one company receiving $30 million in project financing. BTV has hosted or supported more than 54 events in 2018, which ranged from recruiting and supporting companies, to promoting the BTV program. In early 2019, BTV outreach will focus on a few key areas. First, to strengthen connections with Hubs through site visits, attending events, and enlisting program ambassadors to network and promote BTV services. Second, to conduct events at each Hub to help entrepreneurs develop their business with events ranging from startup boot camp to legal issues to grant writing. Third, to work with the Hubs to grow the offering of online resources.
EPC-15-038** BlueTechValley Innovation Cluster	N/A	N/A	Yes; Calif Based Entity	This project will help lead to technology advancements by providing and coordinating key services, assistance, resources, and infrastructure needed by entrepreneurs and researchers to create and develop advanced energy technologies that will help the state meet the targets set by Senate Bill 350 to increase both renewable electricity generation and energy efficiency to 50 percent by 2030.	2a, 3e	As of 2018, BlueTechValley (BTV) has accepted and supported 113 companies into their program (57 companies in 2018) and these companies have received $13.9 million in additional private capital funding and $600,000 in additional public funding in 2018, with one company receiving $30 million in project financing. BTV has hosted or supported more than 54 events in 2018, which ranged from recruiting and supporting companies, to promoting the BTV program. In early 2019, BTV outreach will focus on a few key areas. First, to strengthen connections with Hubs through site visits, attending events, and enlisting program ambassadors to network and promote BTV services. Second, to conduct events at each Hub to help entrepreneurs develop their business with events ranging from startup boot camp to legal issues to grant writing. Third, to work with the Hubs to grow the offering of online resources.
EPC-15-039 Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle	N/A	N/A	Yes; Calif Based Entity	The research project is for the first time determines the impact of large solar arrays on the carbon storage of desert soil ecosystems. Findings will provide insights into the most effective ways to design and manage solar production facilities for maximum net carbon benefits.	2a, 4f	The research team has completed sensor installation at the six sites in Mojave Desert and they are collecting real-time meteorological data and CO2 flux data. The team continued soil sampling in soil trenches excavated at each of the six sites. Completed physical and chemical soil analyses will include: soil water retention curves, soil porosity, soil water permeability functions, organic C/N content and isotopic composition, carbonate content and isotopic composition, and radiocarbon dates. Throughout 2018, the research team collected data from six reference sites in the Mojave desert and started data collection at solar PV facility site. In early 2019, the team will evaluate short- and long-term impacts of land use and climate change on the soil carbon cycle in arid areas.
EPC-15-040 Assessing California's Mitigation Guidelines for Burrowing Owls Impacted by Renewable Energy	N/A	N/A	Yes; Calif Based Entity	This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on burrowing owls. This will be achieved by evaluating the relative effectiveness of primary translocation methods in an experimental framework. Improvements to the effectiveness of existing translocation methods will also be tested experimentally. Long-term GPS tracking of individuals in the active and passive relocation groups and a control group is providing the critical, previously missing, information to judge the effectiveness of each method. The management recommendations and proposed translocation protocols from this study should improve the success of mitigation and facilitate new permitting of renewable energy.	2a, 4f, 4g	By the end of the second season, the research team has captured the targeted number of burrowing owls at development sites for the three treatment groups. They have released the active translocation group of owls at conservation areas. They have monitored the mortality and reproductive success of these owls. In collaboration with their technical advisory committee, they have refined the study design and research protocols and will be making recommendations to wildlife regulatory agencies about translocation protocols. In addition, they have tested GPS units and modified their design for use with burrowing owls. The team shared sample material from captured owls with researchers in EPC-14-061 and EPC-15-043 to extend the data used for isotopic and genetic analyses in those projects.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-041 MarketZero: Taking an existing grocery store to scalable near-ZNE	Technology Demonstration and Deployment	The project implements a cost-effective energy efficiency upgrade package for a grocery store that uses both mature efficiency technology and new innovative technologies. The project includes LED lighting and refrigeration system improvements to increase energy efficiency, changing to a lower global warming potential refrigerant (R448A), and installing high-efficiency variable frequency drive compressors. Other improvements include thermal ice packs in the walk-in freezers to reduce compressor run time during the day and help shift electrical load on hot days, variable speed reluctance motors for the supply fans for new efficient heat pumps, emerging nelumbo coatings for the evaporator coils for self-contained refrigeration cases to improve the efficiency.	4/13/2016	No	Demand-side Management	$2,999,591	$2,999,591	$794,134	N/A	$794,134
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-042 Zero Energy Residential Optimization - Community Achievement (ZERO-CA)	Technology Demonstration and Deployment	The project serves as proof of concept for large-scale deployment of Zero Net Energy (ZNE) single-family homes in California. The objective is to construct ZNE homes without creating undue cost burdens on builders, businesses or consumers, while assuring that changes to home design do not pose health, safety or other risks to occupants. The project also provides industry and regulators with a better understanding of site energy use and renewable energy generation.	5/17/2016	No	Demand-side Management	$4,819,805	$4,819,805	$1,139,277	N/A	$1,139,277
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-043 Development of a Genoscape Framework for Assessing Population-Level Impacts of Renewable Energy Development on Migratory Bird Species in California	Applied Research and Development	This project develops a low-cost method that capitalizes on genomic data to create high-resolution spatial maps of bird populations and migration routes. This technology will be extended to identify migration routes for additional vulnerable and endangered species, assess population-level impacts of fatalities at renewable energy facilities, and map migration hotspots. This information will help with siting decisions of new facilities as well as operational decisions, such as when to turn off wind turbines to avoid vulnerable population fatalities, reducing the overall number of bird losses at renewable energy facilities. Accurate understanding of the distributions of vulnerable populations in space and time will lead to more effective siting, monitoring, and operation, ultimately lowering costs to California ratepayers.	4/13/2016	No	Generation	$599,236	$599,236	$436,022	N/A	$436,022
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-044 Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources	Applied Research and Development	This project developed two key open-source software technologies: 1) implementation of a complete, certified IEEE 2030.5 communication protocol that manufacturers can freely incorporate into their products. This reduces the cost and complexity of bringing systems to market, streamlines the certification process, and helps ensure that products can successfully connect and participate in grid programs; and 2) a certification procedure and associated test software by which any system or device can be checked for compliance to the standard. Independent evaluation provides manufacturers with an unbiased assessment of their products and provides both business and individual consumers with assurance that their purchases will work as expected. The project also validated the completeness and quality of these technologies by implementing the open-source client in a commercial DER system and performing field testing.	5/17/2016	No	Distribution	$816,539	$816,539	$523,523	N/A	$523,523

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EPC-15-041 MarketZero: Taking an existing grocery store to scalable near-ZNE	$846,723	$0	Whole Foods Market;	$650,000	17.8%	Grant	Pre-existing intellectual property identified in agreement EPC-15-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Prospect Silicon Valley	Group 5: Ranked # 2
EPC-15-042 Zero Energy Residential Optimization - Community Achievement (ZERO-CA)	$1,488,701	$0	California Homebuilding Foundation (CHF);	$2,611,014	35.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	California Homebuilding Foundation (CHF)	Group 6: Ranked # 1
EPC-15-043 Development of a Genoscape Framework for Assessing Population-Level Impacts of Renewable Energy Development on Migratory Bird Species in California	$114,850	$0	Regents of the University of California, Los Angeles;	$888,250	59.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Regents of the University of California, Los Angeles	Group 6: Ranked # 1
EPC-15-044 Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources	$203,973	$0	Electric Power Research Institute, Inc.; Xanthus Consulting International; SunSpec Alliance; Enphase Energy; QualityLogic;	$243,722	23.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1

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EPC-15-041 MarketZero: Taking an existing grocery store to scalable near-ZNE	N/A	N/A	Yes; Calif Based Entity	As grocery stores are risk averse especially with new emerging innovative technologies, successful demonstration showing the benefits and performance has the potential to advance these technologies to other stores. As profit margins for grocery stores are between 1 and 3 percent, increases in energy efficiency using these advanced technologies will be beneficial to a store's bottom line. Also, these types of improvements pose challenges to grocery stores due to limited space and existing configurations. However, documenting cost, savings and benefits could influence the grocery market to make similar future upgrades. These solutions and design approaches hope to achieve near zero net energy for a grocery store.	1e, 1f, 1h, 4a	The final list of energy efficiency measures to be installed was approved by the CAM. Staff visited the Whole Foods Store in San Francisco in October 2018 and obtained information on the retrofit strategy for the store. The overall project is moving forward and remains on track for all energy efficiency measures to be installed by the end of March 2019.
EPC-15-042 Zero Energy Residential Optimization - Community Achievement (ZERO-CA)	N/A	N/A	Yes; Calif Based Entity	Working closely with the builder and subcontractors, technology costs will be evaluated and will include a real-world perspective by providing actual time and labor spent to install and commission each of the new technologies versus only the technology cost. By providing this data and analysis on the approximate 50 homes being constructed, this project will serve as a roadmap toward the most effective ways to implement ZNE homes. The information gathered will be disseminated through various project participants such as California Building Industry Association (CBIA) events and member newsletters in efforts to promote the potential for cost-effective ZNE to the builder community.	1f, 1h, 3b, 4a	The project has started construction on the first phase of ZNE Homes. A ZNE analysis report that provides an assessment of the relative cost-effectiveness of various prescriptive and above-code energy efficiency measures that can help drive California residential construction towards achieving ZNE was completed. The team is currently finalizing details for the monitoring and verification system that will be implemented. Portions of the monitoring has begun such as monitoring attic conditions to understand thermal performance and potential for moisture-related risks for air-permeable insulation systems in unvented attics. Additional measures are still being explored for energy savings such as home energy management systems and battery storage.
EPC-15-043 Development of a Genoscape Framework for Assessing Population-Level Impacts of Renewable Energy Development on Migratory Bird Species in California	N/A	N/A	Yes; Calif Based Entity	This project harnesses the power of genomic data to develop genetic assays for quick, low cost screening of thousands of individuals. Researchers are creating high-resolution maps of population structure and migration routes and applying this information to assess population-level impacts by screening carcasses collected from renewable energy facilities. Genoscape maps are being merged with existing spatial data of energy potential to make recommendations for siting new facilities in areas with minimal impact on wildlife.	2a, 4g	The research team has collected samples for the selected set of birds (Common Yellowthroats, Burrowing Owls, and American Kestrel plus others being studied with match funds) and completed genetic analysis to map distinct populations. Some of the Burrowing Owl samples were obtained from EPC-15-040. In Fall 2017, the researchers developed maps and schedules of the migration routes (genoscape maps) relative to renewable energy sites. They collected samples from bird carcasses killed at solar and wind facilities (some obtained from EPC-14-061) to use the genetic methods to determine the population to which the dead birds belonged to estimate the population-level effects. They have developed their approach for prioritizing migratory hotspots with input from the TAC and others. Multiple journal articles are being written.
EPC-15-044 Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources	N/A	N/A	Yes; Calif Based Entity	This project helps accelerate availability and connection of DER products and systems in California that meet Rule 21 requirements. This will also help more rapidly increase grid-tied solar generation to meet California's aggressive solar mandates.	1a, 1h, 1i, 2a, 3a, 5a	The EPRI team developed the first free, open-source client software of the IEEE 2030.5 communication standard for DERs. This software enables manufacturers to deliver the next generation of intelligent DER devices and systems. Moreover, the project also developed the test procedure and the associated test software by which DERs can be checked for compliance to the IEEE 2030.5 standard. The project team overcame several challenges including late release of IEEE 2030.5 to deliver these key technologies to the state of California. The open source software has been integrated in a commercial DER gateway and was successfully tested at an Enphase laboratory.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-045 Transactive Incentive Signals to Manage Electricity Consumption for Demand Response	Applied Research and Development	This project develops Transactive Load Management (TLM) signals, expressed in the form of proxy prices reflective of current and future grid conditions, and develops and implements software to calculate such signals. These signals are being designed to provide customers sufficient information to optimize their energy costs by managing their demand in response to system needs. The signals are transported via proven and available protocols and networks for use by projects that will test the efficacy of the TLM signals using the demand response projects awarded under GFO-15-311, Advancing Solutions that allow Customers to Manage Their Energy Demand.	5/17/2016	No	Grid Operations/Market Design	$498,054	$498,054	$259,071	N/A	$259,071
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-046 Developing a Distribution Substation Management System	Applied Research and Development	This project is developing a software which will show the current state of the distribution system, detect problems, and automatically suggest potential solutions to reduce outage times. The software also helps automate routine and non-routine engineering and maintenance tasks that are performed on substation equipment, such as monitoring voltage violation.	5/17/2016	No	Distribution	$500,000	$500,000	$309,024	N/A	$309,024
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-047 Powernet - A Cloud Based Method for Managing Distribution Resources	Applied Research and Development	This project will further develop Powernet, a cloud-based method to manage energy resources in homes and businesses. Powernet will control and coordinate energy resources both behind the meter and at the distribution system for residential and commercial ratepayers to: (I) minimize costs, (ii) increase consumer quality of service, (iii) preserve grid stability and (iv) offer services to the grid.	5/17/2016	No	Distribution	$2,210,720	$2,210,720	$1,794,391	N/A	$1,794,391
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-048 Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources	Applied Research and Development	This project tests and validates an intelligent residential energy management system that is capable of communicating with a variety of distributed energy resources (DER) including solar PV and energy storage in 100 residences in San Diego. The project integrates the use of pilot time-of-use utility rates in conjunction with simulated dynamic pricing signals to optimize grid impact and cost savings.	5/17/2016	No	Demand-side Management	$3,996,560	$3,996,560	$2,174,231	N/A	$2,174,231
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-050 Winery Water and Energy Savings	Technology Demonstration and Deployment	This project is testing two energy and water saving technologies at a winery facility in northern California. The first technology is a water treatment and reuse system to recycle wastewater for indoor barrel washing. The second is a wine-to-wine heat exchanger for the cold-stabilization process -- a process through which white wine is cooled to a low 28 degree Fahrenheit and then heated back up to 55 degree Fahrenheit. Both technologies are to be installed on a single skid at the project location in Sonoma County, along with monitoring and verification equipment. Jackson Family Wines owns the bottling facility where the technologies are being tested.	5/17/2016	No	Demand-side Management	$1,989,201	$1,989,201	$871,323	N/A	$871,323

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EPC-15-045 Transactive Incentive Signals to Manage Electricity Consumption for Demand Response	$126,585	$0	Greenlots;	$110,450	18.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Electric Power Research Institute, Inc.	Group 3: Ranked # 1
EPC-15-046 Developing a Distribution Substation Management System	$171,526	$0	Siemens Corporation, Corporate Technology;	$455,000	47.6%	Grant	Pre-existing intellectual property identified in agreement EPC-15-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Siemens Corporation, Corporate Technology	Group 2: Ranked # 3
EPC-15-047 Powernet - A Cloud Based Method for Managing Distribution Resources	$865,939	$3,500,000	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	SLAC National Accelerator Laboratory	Group 2: Ranked # 4
EPC-15-048 Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources	$938,190	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Alternative Energy Systems Consulting, Inc.	Group 2: Ranked # 2
EPC-15-050 Winery Water and Energy Savings	$157,088	$0	Jackson Family Wines ;	$404,625	16.9%	Grant	Pre-existing intellectual property identified in agreement EPC-15-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Regents of the University of California, Davis	Group 2: Ranked # 5

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-045 Transactive Incentive Signals to Manage Electricity Consumption for Demand Response	N/A	N/A	Yes; Calif Based Entity	This project has developed a day-ahead hourly proxy price signal that incorporates system conditions as reflected by wholesale energy markets. The hourly prices are being made available on a publicly-accessible server and are being incorporated as one of the experimental pricing structures being evaluated in EPIC demand response projects funded under GFO-15-311 in order to assess the potential for a variety of different loads and customer types to respond automatically to a real-time proxy pricing signal, and by extension, the potential of DR being a Demand Side or a supply side resource for the State.	1c, 1d, 1e, 1f, 1g, 1h, 3c, 3e, 3f, 3h, 4a, 5a, 5b	The project is on schedule and will be completed in the first Quarter of 2019. The reference design for the Transactive Load Management signal was implemented in early 2018 and has been providing the 24-hour ahead real-time signal continuously since then. All interim deliverables have been received and the draft Final Report is expected January 30, 2019.
EPC-15-046 Developing a Distribution Substation Management System	N/A	N/A	Yes; Calif Based Entity	Highly automated and efficient grid operation is required to achieve California's energy goals, in particular with respect to the Clean Energy and Pollution Reduction Act of 2015 (Senate Bill 350) that strives to reach 50 percent renewable energy resources. This project will lead to technological advancement and breakthroughs to overcome barriers in electrical grid automation by demonstrating the potential of semantic technologies for categorizing and processing data, as well as for discovering relationships within a varied data set. This system will allow operators to control and further automate routine and non-routine engineering and maintenance tasks that are performed on substations. By making the complex smart grid more accessible for operators, it will permit faster resolution of outages, thereby making the grid more maintainable and resilient.	3a, 3d, 5f, 5h	The Siemens team completed software development and added new functionalities this year. The system is now able to detect anomalies and download, install and configure a specific piece of software or app to fix the problem detected on a faulty substation. The team also built an augmented reality application that allows grid operators to have an immersive experience with a global view of a cluster of substations. The system allows operators to visualize the operating status of the substation, issues that arise, and status of fixes for the issues. All the technical tasks of this project are completed. The project concludes in March 2019.
EPC-15-047 Powernet - A Cloud Based Method for Managing Distribution Resources	N/A	N/A	Yes; Calif Based Entity	Several significant Powernet system innovations will be developed under this agreement: (I) The integration of control, optimization and power electronics will enable novel functionality that includes stable connect/disconnect from the grid, local and global power sharing, and grid services including demand response; (ii) The layered structure of the system will enable the operator to utilize Powernet for a variety of different grid purposes or service offerings with the assurance that those are always done on top of an economically optimal operating point every second; (iii) The system will be robust and secure by design; and (iv) The system will adopt open source standards and protocols for the platform to enable scalable engagement of devices in the future.	1g, 2a, 3a, 3d, 3f, 5f, 5h	The project team made progress in the following areas: 1) identified a new site location when the previous site backed out, 2) developed a simulation platform that can accommodate up to 10K houses and includes detailed models of the cloud coordinator and markets; 3) evaluated the behavior and the performance of the system when controlling demand response of the appliances and devices in the houses; 4) developed, constructed and began tests in the lab of the residential battery energy storage system, residential roof top solar, electric vehicle charging stations and household appliances; and 5) continued finalizing the software and hardware architecture for the technologies that are going to be deployed in the participating homes.
EPC-15-048 Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources	N/A	N/A	Yes; Calif Based Entity	The key advancement in this project will be the operational integration strategies being developed and tested in the field. If proven successful through field testing, this system has the potential of achieving widespread deployment throughout the state which could significantly reduce peak demand, reduce annual energy costs, and improve grid operations.	1e, 1h, 2a, 4a	Progress this year includes finalizing the pilot test design, recruiting 100 test participants, getting stakeholder feedback through technical advisory meetings, and completing pilot test home installations. Other activities underway include ongoing commissioning at test sites, and initiating data collection activities. As of December 2018, all installations at the 100 test sites have been completed. Energy Commission staff conducted a site visit to San Diego in December 2018.
EPC-15-050 Winery Water and Energy Savings	N/A	N/A	Yes; Calif Based Entity	The project focuses on full-scale technology demonstrations of two water and energy saving technologies for the wine industry. The water treatment and reuse system uses reverse osmosis to treat water to potable standards for barrel washing with an estimated water savings of 90 percent at the facility. The second technology is an innovative wine-to-wine heat exchanger for the cold-stabilization of the white wine that reutilizes the thermal potential of existing cooling and heating streams which reduces the amount of energy used for processing white wine.	1f, 1h, 2a, 4a, 4c	The water treatment and reuse and the wine-to-wine heat exchanger systems have been installed and commissioned and a full-scale demonstration began October 2018. The project team developed a Measurement and Verification Plan and has begun a 12-month measurement of the water and energy savings for both the water treatment and reuse system, and the wine-to-wine heat exchanger.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-051 The Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings	Applied Research and Development	This project identifies, quantifies and evaluates the incremental costs and benefits of demand responsive (DR) lighting controls system requirements in the California Energy Code across existing, non-residential building stock. The project focuses on the incremental costs and benefits associated with adding the DR functionality to enhance general lighting upgrades in existing, non-residential buildings to enable them to act as DR resources.	5/17/2016	No	Demand-side Management	$500,000	$500,000	$500,000	N/A	$500,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-053 Customer-Centric Approach to Scaling IDSM Retrofits	Technology Demonstration and Deployment	This project develops and demonstrates an approach to scale residential retrofits for disadvantaged communities that will focus on customer-centric solutions. This project develops and demonstrates an innovative approach, focusing on energy efficient retrofit packages that are non-intrusive to occupants and have the potential of reducing energy use by 30 to 40 percent.	5/17/2016	No	Demand-side Management	$3,894,721	$3,894,721	$927,278	N/A	$927,278
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-054 Complete and Low Cost Retail Automated Transactive Energy System (RATES)	Applied Research and Development	This project will develop and pilot-test a standards-based Retail Automated Transactive Energy System (RATES), and behind the meter energy management solution. The purpose is to minimize the cost and complexity of customer participation in energy efficiency programs, maximize the potential of small loads to improve system load factor, shave peaks, integrate renewable generation, and provide low opportunity-cost resources to the grid. This project will work with Southern California Edison to facilitate customer participation and expand Demand Response Participation in the area served the Moorpark substation.	5/17/2016	No	Demand-side Management	$3,187,370	$3,187,370	$2,493,558	N/A	$2,493,558
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-055 The Charge Bliss Advanced Renewable Energy Community for a Disadvantaged Southern California Community	Market Facilitation	This project demonstrated how the City of Carson's disadvantaged downtown community could plan and design an advanced energy community that included an extensive electric vehicle charging network, high penetrations of photovoltaic (PV) generation, and stationary battery storage in their municipal parks and city-owned facilities. The project team used transportation and utility data to develop a plan for where to place EV charging stations within areas with high electric grid congestion and how the associated increased energy demand could be balanced with solar and storage to minimize grid impacts. The team conducted planning, permitting, financial modeling, and engineering design for over three megawatts of PVs and 40+ charging stations for a disadvantaged public sector and commercial area in the City of Carson. Charge Bliss collaborated with two local government entities, South Bay Cities Council of Governments, and Southern California Association of Governments, as well as a collection of universities and private companies on this effort.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,322,212	N/A	$1,322,212

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EPC-15-051 The Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings	$130,529	$0	Energy Solutions;	$138,648	21.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Lawrence Berkeley National Laboratory	Group 4: Ranked # 1
EPC-15-053 Customer-Centric Approach to Scaling IDSM Retrofits	$1,316,714	$0	Southern California Edison; BIRA Energy; LINC Housing Corporation;	$799,559	17.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Electric Power Research Institute, Inc.	Group 5: Ranked # 3
EPC-15-054 Complete and Low Cost Retail Automated Transactive Energy System (RATES)	$0	$0	Universal Devices, Inc.; TBD - Controls; TBD Electrical Contractor; TeMix, Inc.;	$1,087,710	25.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Universal Devices, Inc.	Group 2: Ranked # 4
EPC-15-055 The Charge Bliss Advanced Renewable Energy Community for a Disadvantaged Southern California Community	$197,815	$0	Efacec; Edward Kjaer; Ji Min; Tanner Engineering;	$96,937	6.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Charge Bliss, Inc.	Group 4: Ranked # 3

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EPC-15-051 The Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings	N/A	N/A	Yes; Calif Based Entity	This project will advance intelligent, network controls to become dynamically controlled, dispatchable grid resources. The advanced controls developed will ease building participation in Auto-Demand Response (DR) programs and improve grid reliability and resiliency, improve user interfaces for lighting systems to reduce energy waste and cost, and enable IOUs and others to geographically target DR deployments as a cost effective means to transmission and distribution infrastructure upgrades.	1e, 1f, 1h, 5b	The project is complete. Research results indicate that networked lighting control systems will become an important distributed energy resource (DER) because it increases lighting system efficiency, flexible control and rapid-response capabilities, and eases load aggregation. As more facilities recognize the non-energy benefits of net worked lighting control systems, these systems are expected to see increased market adoption along with decreased prices. Additionally, as the electricity market becomes more volatile, these systems could help with grid balancing and stabilization. The final report will be published in January 2019.
EPC-15-053 Customer-Centric Approach to Scaling IDSM Retrofits	N/A	N/A	None	The project provides new data, analysis, and designs for cost-effective integrated demand side management retrofits such as advanced HVAC, smart thermostats, plug load controls, LED lighting, and heat pump water heaters for residential communities. These retrofits are designed to minimize tenant disruptions.	1f, 1h, 4a, 5b	For the Ontario site: The research team has completed installation of efficiency measures and has begun a 12-month monitoring and commission period. Technologies installed at Ontario include: HVAC heat pumps, attic insulation, upgraded windows, LED lighting, high efficiency appliances, smart thermostats, and fault detection diagnostic equipment. For the Fresno site installation is underway. Technology upgrades in Fresno include wall installation and dual pane window retrofits. In 2019, they plan to upgrade HVAC and water heaters.
EPC-15-054 Complete and Low Cost Retail Automated Transactive Energy System (RATES)	N/A	N/A	Yes; Small Business, Calif Based Entity	This project is developing an energy management automation platform that will allow customers to participate in Demand Response (DR) markets by providing them the means to pre-program their preferred operational settings for end-use devices such as thermostats, pool pumps, and battery storage under variable pricing conditions. The technology is applying those preferences to automating real-time response to energy market and rate variations using off-the-shelf equipment and a two-way subscription tariff design that allows customers to consume when prices are low and conserve when prices are high, without the need for complicated measurement, verification, and baselines. This technology will reduce barriers to low cost, anytime responsiveness from millions of customers and their devices by solving the significant cost and complexity of current DR participation options.	1c, 1e, 1f, 1g, 1h, 3f, 4a	The project is on schedule, required deliverables have been provided, and the level of engagement by utilities and other partners is expanding the project impacts beyond what was initially anticipated in the agreement. SCE has provided additional funding to support expansion of the research in the Moorpark substation area (a Disadvantaged Community also at risk for reliability issues). In addition, Google has been working with the team to evaluate its Alexa technology as a platform for hosting the transactive client. Demonstrations are underway and SCE has provided funding to expand the number of test sites and include battery storage in the pilot, as well as facilitating expanded participation in CAISO markets by developing and getting CPUC approval for an experimental tariff tailored to this project. The final report is anticipated January 10, 2019.
EPC-15-055 The Charge Bliss Advanced Renewable Energy Community for a Disadvantaged Southern California Community	N/A	N/A	Yes; Micro Business, Calif Based Entity	SB 350 (2015) sets a 50 percent renewable energy standard by 2030 and a doubling of energy efficiency savings in buildings by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project piloted innovative planning, permitting financing, and engineering approaches and tools to help improve the business case for IDER adoption at the community-scale.	3b, 3e	The project team worked with community, technical, and civic stakeholders to develop a plan that selected the best public buildings and parks to install energy storage, an extensive electric vehicle charging network, photovoltaic, and smart control technology -- keeping in mind impacts to the grid, ZNE status, and cost. After completing the engineering design documents, the complete package was submitted to Carson. However, as of the end of 2018 the city chose not to further peruse the proposed development. This project demonstrated that early and frequent engagement with the community and civic leadership is an important aspect for advanced energy community efforts to avoid delays and re-designs that may arise from issues such as the need to compensate for pre-existing community priorities.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-056 Peninsula Advanced Energy Community (PAEC)	Market Facilitation	Clean Coalition planned and designed a Solar Emergency Microgrid (SEM) for the southern portion of San Mateo County. The team developed several case studies to guide SEM site selection based on which services would be included and their implicit or minimum loads, facility type, interconnection options, resources available, proximity of the site to local hazards, and available financing options. The project team used the case studies to inform their work with the local planning and building departments to streamline zoning and engineering permitting for optimal SEM sites. To help incentivize microgrid investments, including for the project's SEM, the project team worked to establish a backup power valuation methodology to use in commercial applications.	5/17/2016	No	Demand-side Management	$1,318,997	$1,318,997	$1,141,781	N/A	$1,141,781
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-057 Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings	Applied Research and Development	The purpose of this project is to improve small and large commercial customer participation in demand response programs by providing a cost-effective energy management system that allows a wide range of service offerings as well as effective and automated price-based management. The project will develop automated control systems capable of responding to dynamic pricing and program designs. Design improvements include: 1) receive price signals and evaluate energy demand; 2) enable heterogeneous customers to adapt to DR with individual preferences; 3) track, evaluate and control multiple devices; 4) interoperate with various building systems; 5) retain the electrical usage history of connected devices; 6) provide pricing based load management algorithms; 7) coordinate to maintain load diversity; 8) provide security; and 9) provide value by allowing customers to minimize the opportunity costs of participating by selecting the least-impactful load management strategy.	5/17/2016	No	Demand-side Management	$4,000,000	$4,000,000	$1,126,095	N/A	$1,126,095
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-058 The Oakland EcoBlock - A Zero Net Energy, Low Water Use Retrofit Neighborhood Demonstration Project	Market Facilitation	This project developed a model for a residential block-scale retrofit development of an integrated energy system combining energy efficiency, renewable generation, and water conservation technologies, called the EcoBlock. The development of the energy and water system components of the model served as a case study to analyze different owner-operator, and financing structures that may be applicable to a residential community. This case study can help transform the EcoBlock model from a one-off demonstration to a sustainable and replicable model for the entire state. The City of Oakland will also use the EcoBlock model to develop new planning and permitting processes that can lower the time and cost of similar block-scale developments throughout the city.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$723,393	N/A	$723,393
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-059 UniGen Smart System for Renewable Integration	Applied Research and Development	This project is developing the UniGen Smart Software System to smooth energy output from a combination of variable energy resources (VER). VER generation often deviates from forecasts and schedules because of variations in weather. This can be alleviated by a fast-acting control system that automatically compensates for deviations from projected generation using a dedicated mix of energy resources (e.g., a photovoltaic system and an energy storage system). Onset's UniGen control system would couple these resources with a primary power plant using proprietary algorithms in a software application in real time so that the combined output corresponds to the committed output. Any deviation is solved at the project or distributed level, making it easier for the California Independent System Operator (CAISO) to manage grid performance.	5/17/2016	No	Grid Operations/Market Design	$638,993	$638,993	$521,091	N/A	$521,091

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EPC-15-056 Peninsula Advanced Energy Community (PAEC)	$312,711	$0	Natural Capitalism Solutions, dba Clean Coalition;	$330,000	20.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Natural Capitalism Solutions, dba Clean Coalition	Group 1: Ranked # 3
EPC-15-057 Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings	$1,373,762	$0	Quantum Energy Services and Technologies, Inc. (DBA: QuEST); Siemens Corporation, Corporate Technology;	$424,000	9.6%	Grant	Pre-existing intellectual property identified in agreement EPC-15-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	The Regents of the University of California (CIEE)	Group 2: Ranked # 3
EPC-15-058 The Oakland EcoBlock - A Zero Net Energy, Low Water Use Retrofit Neighborhood Demonstration Project	$117,432	$0	The Regents of the University of California on behalf of the Berkeley campus; Rexel Foundation; Morgan, Lewis and Bockius LLP; Arnold and Porter LLP; Perkins Coie;	$769,846	33.9%	Grant	Pre-existing intellectual property identified in agreement EPC-15-058 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	The Regents of the University of California, Berkeley	Group 1: Ranked # 1
EPC-15-059 UniGen Smart System for Renewable Integration	$0	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Onset, Inc.	Group 1: Ranked # 2

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EPC-15-056 Peninsula Advanced Energy Community (PAEC)	N/A	N/A	None	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments are playing a critical role in achieving this goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project is piloting innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in June 2018 and Clean Coalition submitted a finalized master community design and case study, including four SEM models for different sites located in a disadvantaged community. These models integrate solar PV, energy storage, and electric vehicle charging infrastructure (EVCI), to increase resiliency from power outages. The project team is still pursuing a plan to connect all four sites, and is working with PG&E on the design. Additionally, several tools were developed to overcome economic, policy, and technical barriers that hinder AEC development, which include a streamlined permitting tool, a solar siting survey, and an EVCI master plan. The recipient has updated the project-specific page on their website: http://www.clean-coalition.org/our-work/peninsula-advanced-energy-community/.
EPC-15-057 Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings	N/A	N/A	None	This project is developing an open source software solution that is combined with an open architecture enabling platform. The eXtensible Building Operating System (XBOS/DR) can interface with multiple hardware devices from different vendors as well as include software applications from various vendors. With its ability to create a virtual building management system for small commercial buildings by networking thermostats and other controllers, XBOS/DR can provide large and small commercial customers with a variety of choices for DR capability. The open architecture can foster technical innovation by third-party vendors and other manufacturers in providing energy services.	1c, 1e, 1g, 1h, 4a	The project team successfully demonstrated the transactive signal server in a dispatch demonstration as well as preparing the Packaging, Configuration, and Distribution Scripts Report, which describes how to download and configure the XBOS software. All installations in the small commercial buildings were completed. Training has begun for facilities managers on the new interface, and feedback will be sought from the managers to determine response priorities and strategies. The project team will finish developing baseline strategies for all buildings as a basis for evaluating the DR strategies and energy efficiency measures being tested. The field testing report is due June 2019. The project was extended six months in order to leverage DOE funding to pursue using the XBOS platform to control loads based on micro-synchrophasor data. The Final Report is expected in July 2019.
EPC-15-058 The Oakland EcoBlock - A Zero Net Energy, Low Water Use Retrofit Neighborhood Demonstration Project	N/A	N/A	Yes; Calif Based Entity	SB 350 (De Leon, 2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Deploying customer-side of the meter technologies at scale will help meet this goal, but will require new innovations to how local jurisdictions design, plan, finance, and manage energy upgrades at the community level. This project is developing sustainable financing structures, clear owner-operator responsibilities, and streamlined planning and permitting processes, which are critical to successfully deploying community-scale energy retrofits throughout the state.	2a, 3b, 3e	The project team completed a Community-Scale Zero Net Energy Retrofit Master Plan that includes 27 houses and 2 multi-family buildings in Oakland. The plan features a DC solar, storage, EV microgrid; energy efficiency retrofits; hybrid AC/DC homes; and a house scale water efficiency systems. The planned systems are estimated to reduce block-wide CO2 emissions by about 65 percent, with near zero net energy reduction at the house scale. The project also identified Community Facilities Districts (CFD) as a viable mechanism for residents to collectively finance communal energy and water installations--both upfront capital and ongoing O&M costs--via assessments on property tax bills. The City of Oakland is using the results of this project to examine any needed changes to its planning or permitting policies to accommodate block-scale DER developments such as the EcoBlock.
EPC-15-059 UniGen Smart System for Renewable Integration	N/A	N/A	Yes; Calif Based Entity	This project is developing a software control system that would be a critical tool that can help integrate large amounts of VERs envisioned by California's energy policy (i.e., 33 percent by 2020 and 60 percent by 2030) along with current generation to create a more stable system. This software control system can simplify the CAISO's energy balancing efforts.	1a, 1h, 2a, 3a, 5a	Draft final report is late, but CAM working to obtain and review. New CAM just assigned after previous CAM retired.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-060 Optimizing Solar Facility Configuration Effects on Habitat, Managed Plants, and Essential Species Interactions	Applied Research and Development	This research quantifies how microhabitat conditions that affect rare plants, invasive plants, and sensitive insects vary across a gradient of solar energy configuration, including sites within a solar field, mitigation areas within a solar field, sites on the margin of a solar field, and similar undisturbed locations. Researchers are determining how habitat variation affects target plant species and their essential species interactions, including herbivory, predation, and pathogens.	5/17/2016	No	Generation	$597,865	$597,865	$331,684	N/A	$331,684
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-061 Using Data-Driven Approaches to Design Advanced Energy Communities for Existing Buildings	Market Facilitation	This project funded the planning, permitting, and preliminary engineering needed for the integration of advanced energy technologies in a disadvantaged community. The final design provides locally generated, GHG-free electricity from community solar and storage to offset electricity consumption of participants who opt in to the program. The design also enables participants to benefit from savings resulting from various onsite retrofits that enable better energy efficiency, energy management, and demand response. Participants will pay back retrofit costs and cost of capital for solar and storage assets through an on-bill financing mechanism, including a first-of-its-kind virtual net metering tariff across multiple county-owned sites and residential buildings piloted by Los Angeles Community Choice Energy. The project team developed robust data evaluation methods using the LA County Energy Atlas to efficiently and effectively identify high-need customers and site locations and to optimize project design and financing features. More information can be found at the project website: https://www.advancedenergycommunity.org/	5/17/2016	No	Demand-side Management	$1,497,996	$1,497,996	$851,246	N/A	$851,246
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-062 Robust, Low-Cost, Real-Time, NOx Sensor for Optimization of Dispatchable Distributed Generation Systems	Applied Research and Development	The project tests several recently developed sensors with the capability to detect low NOx levels generated by dispatchable generation systems, such as internal combustion engines and/or microturbines. Deploying clean, efficient, distributed generation systems directly addresses goals stated in AB 32, SB 350, and the Clean Energy Jobs Plan. While reducing greenhouse gases and improving efficiency are vital, maintaining strict air emission standards is also important. DG systems often suffer performance degradation over time once deployed. This may lead to increased emissions of air pollutants, such as NOx. The proposed solution offers a cost effective means to monitor the real time emissions of the system and information that can be used to optimize system performance and maintain low emissions.	5/17/2016	No	Generation	$200,000	$200,000	$167,135	N/A	$167,135
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-064 Innovative Net Zero: ZNE Demonstration in Existing Low-Income Mixed-Use Housing	Technology Demonstration and Deployment	This project was to demonstrate the installation of innovative energy efficiency technologies in a retrofit of an existing, low-income, mixed-use multi-unit building in a dense urban setting to become zero net energy (ZNE). The recipient was unable to identify cost effective retrofits that met the requirements of the grant. As a result, the agreement was mutually terminated.	5/17/2016	No	Demand-side Management	$2,995,653	$2,995,653	$374,309	N/A	$374,309

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-060 Optimizing Solar Facility Configuration Effects on Habitat, Managed Plants, and Essential Species Interactions	$104,801	$0	Regents of the University of California (University of California, Davis); The Regents of the University of California, Santa Cruz;	$103,297	14.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Regents of the University of California, Davis	Group 6: Ranked # 3
EPC-15-061 Using Data-Driven Approaches to Design Advanced Energy Communities for Existing Buildings	$449,666	$0	Regents of the University of California, Los Angeles; Los Angeles County Office of Sustainability;	$381,074	20.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Regents of the University of California, Los Angeles	Group 4: Ranked # 1
EPC-15-062 Robust, Low-Cost, Real-Time, NOx Sensor for Optimization of Dispatchable Distributed Generation Systems	$53,531	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Irvine Advanced Power and Energy Program	Group 11: Ranked # 8
EPC-15-064 Innovative Net Zero: ZNE Demonstration in Existing Low-Income Mixed-Use Housing	$408,130	$0	Chinatown Community Development Center;	$800,000	21.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Prospect Silicon Valley	Group 5: Ranked # 4

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-060 Optimizing Solar Facility Configuration Effects on Habitat, Managed Plants, and Essential Species Interactions	N/A	N/A	Yes; Calif Based Entity	This project will provide methods to decrease adverse environmental impacts of solar energy facilities and enhance the ability to predict and overcome costly invasions of non-native plants in early stages. This research will also advance the effectiveness of mitigation measures, reduce impacts, and overcome barriers to facility siting and design by studying species responses in different conditions within a solar array and the changes in species interactions.	2a, 3a, 4f	The project team set up the field experimental sites. They completed the data collection and analysis on microhabitat factors and are completing the experimental analyses. The photovoltaic-annual plant experiment is studying the effects of solar panels on temperature, moisture, and photosynthetically active radiation in their microhabitat and how those changes affect the growth, survival, and reproductive success of native and invasive species. Similarly, the concentrating solar-milkweed experiment is studying how changes in soil microhabitat caused by heliostats are affecting the success of a rare milkweed and its dependent butterflies, and the interactions with avian predators. The team held a technical advisory committee meeting in 2017; and a second meeting is in the planning stages.
EPC-15-061 Using Data-Driven Approaches to Design Advanced Energy Communities for Existing Buildings	N/A	N/A	Yes; Calif Based Entity	Local governments can play a critical role in achieving the state's SB 350 (2015) building energy efficiency goals by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) for energy efficiency. This project is piloting innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in March 2018. The project has resulted in a shovel-ready AEC design in preparation for Phase II and has made several findings towards lowering barriers to access to energy efficiency and solar in local DACs. The implementation of a VNEM tariff was critical in showing financial viability of the design since it allows community members to share the benefits of local renewable power even if they cannot or prefer not to install solar panels and/or an energy storage system on their own property. The project team found that the existence of a Community Choice Aggregator (CCA) allows for streamlined deployment of a VNEM tariff, which may not be the case in areas without a CCA.
EPC-15-062 Robust, Low-Cost, Real-Time, NOx Sensor for Optimization of Dispatchable Distributed Generation Systems	N/A	N/A	Yes; Calif Based Entity	The NOx sensor is based on ceramic solid-state electrochemical sensor technology, similar to an automotive oxygen sensor. Solid state NOx sensors have been developed for direct in-situ measurement of exhaust to meet stringent on-board diagnostic requirements for self-diagnosis and reporting, including required sensitivities down to parts-per-million. The NOx sensor combines existing commercial NOx sensors with newly developed electronics for use in applications, including dispatchable distributed generation like microturbines. Unlike other NOx sensors, the sensor is a simple solid state device, with a single cell and no internal diffusion chambers (electrodes directly in the flow). This gives it faster responsiveness, and makes it both more robust and easier to manufacture.	2a, 3f, 4b	The research team has completed the technical work and submitted the draft final report. The results show that the two automotive solid state NOx sensors selected proved durable enough to perform reliably for the 6-month evaluation. The research team developed an engine control system integrated with information from the solid state NOx sensor and successfully demonstrated the ability to actively reduce NOx emissions at part load by 10%. The results show that solid state sensors represent an inexpensive and viable approach for monitoring emissions from distributed generation systems.
EPC-15-064 Innovative Net Zero: ZNE Demonstration in Existing Low-Income Mixed-Use Housing	N/A	N/A	Yes; Calif Based Entity	The project site represented a test case for many of the complex challenges facing zero net energy retrofits of multi-unit, mixed-use buildings. If successful, the project approach could have been packaged for broad dissemination to the design community.	1f, 1h, 4a	On July 13, 2017, PSV informed Energy Commission staff that the project would require an unanticipated $1 million electrical upgrade in order to install the selected retrofit measures and the PV system. PSV attempted to identify alternative financing to fund the electrical service upgrade and identify new measures that could be installed using the existing electrical service. It also explored options for doing the project at a different site. However, it was unable to identify a suite of acceptable retrofit measures and a site that met the solicitation requirements and could be completed within the term of the agreement. PSV agreed to a mutual termination of the project. The termination was approved at the September 21, 2018 Business Meeting.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-065 Berkeley Energy Assurance Transformation (BEAT) Project	Market Facilitation	The BEAT project focused on designing a clean energy microgrid for the public good that could be integrated into the existing fabric of a dense urban city. The project analyzed the feasibility of designing a multi-building, urban microgrid that uses solar and energy storage to share power between existing buildings to better regulate day-to-day energy supply. Additionally, in the case of a power outage, the microgrid would be able to "island" itself from the grid and provide clean back-up power for critical buildings. The BEAT team conducted a series of coordinated regulatory, technical and financial analyses to determine site feasibility, optimal configurations, operation criteria, financing strategies, and lessons learned. The financing and regulatory models provide pathways and recommendations for dense urban communities looking to develop microgrids that cross the public right-of-way. Using this analysis, other microgrid projects will be able to evaluate the benefits and challenges of urban microgrids and accelerate the non-technical planning, modeling, and financing options for microgrid and/or solar + storage projects.	5/17/2016	No	Demand-side Management	$1,499,214	$1,499,214	$1,269,149	N/A	$1,269,149
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-066 Developing an Advanced Energy Master Plan for the Encanto Neighborhood in San Diego	Market Facilitation	This project developed a prototype plan, called the Encanto Social-Economic Education Development (EnSEED) that attempts to overcome the social, financial and physical barriers to deploying emerging clean energy technology solutions in disadvantaged communities. As part of this project, the project team piloted several digital and in-person outreach strategies to the community, designed to transform an existing disadvantaged community in Southeastern San Diego into a community of near-zero net energy (ZNE) buildings. This project sought close engagement with the local community, and developed a final system design of a community-scale DER deployment as well as an accompanying financing plan. The project also developed a permitting plan that documented the necessary permit processes and required government review and approvals for deploying community-scale DER developments.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,421,437	N/A	$1,421,437
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-067 Integrated Community Resource Marketplace	Market Facilitation	This project developed a platform, called the Integrated Community Resource Market (ICRM), that utilizes the City of Fresno's existing policy and development plans, stakeholder input, and additional research, to compile a comprehensive list of development projects that are financially viable, align with current policy goals and timelines, and, upon implementation, produce verifiable savings of energy, greenhouse gas, and water. With a portfolio of projects identified, the project team used the platform to analyze each project to identify options for funding and financing the project, and carried out a financial analysis of each project to examine energy cost savings, incremental measure cost, return-on-investment in the form of payback with and without funding incentives, and property value improvement. This analysis was combined to develop a Master Community Design, which describes a suite of projects and specific processes for Fresno to consider adopting. Additional information is available at the project website: https://www.lgc.org/energize-fresno/	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,298,452	N/A	$1,298,452

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-065 Berkeley Energy Assurance Transformation (BEAT) Project	$500,070	$248,009	URS Corporation; Center for Sustainable Energy; Office of Energy and Sustainable Development, City of Berkeley; West Coast Code Consultants Inc.; NHA Advisors; Bay Area Regional Energy Network;	$250,121	14.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Office of Energy and Sustainable Development, City of Berkeley	Group 1: Ranked # 4
EPC-15-066 Developing an Advanced Energy Master Plan for the Encanto Neighborhood in San Diego	$129,898	$0	Blue Flame Energy Finance;	$520,000	25.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-066 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Groundwork San Diego-Chollas Creek	Group 4: Ranked # 2
EPC-15-067 Integrated Community Resource Marketplace	$432,890	$0	Local Government Commission;	$12,445	0.8%	Grant	Pre-existing intellectual property identified in agreement EPC-15-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Local Government Commission	Group 3: Ranked # 3

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EPC-15-065 Berkeley Energy Assurance Transformation (BEAT) Project	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) set a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments are playing a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project is piloting innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in June 2018. The recipient aimed to create a shovel-ready design for an islandable, clean energy microgrid community by integrating buildings located throughout downtown Berkeley. However, challenges with crossing the public right-of-way on existing distribution lines between these non-adjacent buildings, as well as the high-cost for new distribution lines and a lack of incentives through PG&E's current tariff structure made the original design cost-prohibitive. The project team changed directions and opted to create designs for separate solar + storage systems, coupled with energy efficiency measures and smart building operation at three locations. The design allows the city to meet its resiliency goals, reduce utility energy consumption by 36-43 percent, and reduce its existing reliance on backup diesel generators during power outages, by up to 40 percent.
EPC-15-066 Developing an Advanced Energy Master Plan for the Encanto Neighborhood in San Diego	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving the goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community scale.	2a, 3b, 3e	This project completed in 2018. As part of the project, the project team conducted a case study to document the various challenges and lessons learned in pursuing a community-scale clean energy system in a disadvantaged community. One of the challenges encountered during the project was that it took nearly eight months to receive community energy-usage data, which prevented the project team from being able to model the system design. As a result, the case study recommended that future teams submit their data requests early in the process. The case study also found that public schools could potentially serve as the location of onsite solar generation for the community since most residences may not have the ability to support rooftop PV.
EPC-15-067 Integrated Community Resource Marketplace	N/A	N/A	Yes; Calif Based Entity	SB 350 (2015) sets a 50 percent renewable energy standard by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and energy storage. This project piloted innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	3b, 3e	This project concluded in March 2018. The project team developed and implemented the ICRM platform on Fresno's Blackstone Avenue Corridor. The platform identified a portfolio of projects and programs that contribute to grid reliability and resiliency, increase energy efficiency and renewable energy, and deploy smart grid and zero net energy technologies. In all, 13 development sites, two activity centers, two program enhancements, and two electric vehicle charging proposals were identified as having the highest potential to provide benefits to Fresno. This portfolio is estimated to cost $30.8 million in capital expenditure and save participants $4.6 million annually net of financing costs, and generate approximately $1 million annually in positive cash flow. The final project report is available at https://www.energy.ca.gov/2018publications/CEC-500-2018-02

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-068 Understanding and Mitigating Barriers to Wind Energy Expansion in California	Applied Research and Development	The research used a combination of global re-analysis datasets, a unique set of observations, and high-resolution global climate model simulations to help identify and characterize the extent to which regions in California may exhibit vulnerability or new opportunity in terms of changes to wind resource magnitude, spatial and temporal variability, and/or operating conditions of sufficient magnitude to alter their viability for wind energy development. The unique strength of this research lies in the use of a next generation variable resolution global climate model that has the ability to simulate climate change over a limited area region, i.e., California, in a computationally cost effective manner.	5/17/2016	No	Generation	$200,000	$200,000	$200,000	N/A	$200,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-069 Lancaster Advanced Energy Community (AEC) Project	Market Facilitation	In collaboration with the City of Lancaster and Lancaster Choice Energy (LCE), this project planned a ZNE microgrid connected to an affordable housing project that enables the cost-effective deployment of advanced technologies. The microgrid design minimizes the impact of increasing renewables on the grid, increases DER design flexibility, enables local control of energy management, and exploits the plummeting cost of islanding capability to provide valuable resiliency benefits to the community. The project team also developed a community DER valuation framework that assesses the value of DERs on an aggregated and integrated network basis from multiple stakeholder perspectives by combining various value streams and evaluating evolving revenue and market participation opportunities. This framework was used to inform the shared services model behind a "Green District" program that integrates storage, solar, and smart building technology as a service for large commercial and industrial customers to reduce their demand charges while allowing LCE to save on procurement costs. More information can be found at the project website: http://www.znealliance.org/projects/lancaster/	5/17/2016	No	Demand-side Management	$1,469,779	$1,469,779	$1,215,620	N/A	$1,215,620
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-070 Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System	Applied Research and Development	This project develops and applies methodology to improve the representation of urban effects in probabilistic and short term forecasts for the electricity system. It quantifies intra-urban climate variability in California for inclusion into electricity demand forecasts used by the Energy Commission and the utilities. The characterizations are based on state-of-science highly-urbanized atmospheric modeling supplemented by analysis of observational weather data. The researcher detailed statistical correlations and analysis focusing on summertime conditions, and developed transfer functions to facilitate use of results by the Energy Commission and utilities.	5/17/2016	No	Grid Operations/Market Design	$193,326	$193,326	$173,767	N/A	$173,767

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EPC-15-068 Understanding and Mitigating Barriers to Wind Energy Expansion in California	$74,830	$0	UC Davis; DNV GL;	$70,000	25.9%	Grant	Pre-existing intellectual property identified in agreement EPC-15-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Lawrence Berkeley National Laboratory	Group 11: Ranked # 2
EPC-15-069 Lancaster Advanced Energy Community (AEC) Project	$507,982	$0	City of Lancaster;	$1,500,000	50.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Zero Net Energy (ZNE) Alliance	Group 2: Ranked # 1
EPC-15-070 Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System	$14,035	$0	Altostratus, Inc.;	$5,000	2.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Altostratus, Inc.	Group 11: Ranked # 6

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EPC-15-068 Understanding and Mitigating Barriers to Wind Energy Expansion in California	N/A	N/A	Yes; Calif Based Entity	This project will help overcome a key barrier to long-term wind energy investment that can help California meet its renewable energy and climate change mitigation goals. Improving the understanding of wind resource magnitude and variability over many time scales and in the context of climate change can improve the precision with which wind resources can be forecast. Technological advancement was realized through use of a next-generation variable-resolution coupled atmosphere-ocean global climate model that is capable of simulating climate and climate change at relatively high spatial resolution (7km to 14km) over California. This was the first time that a variable-resolution climate modeling system has been used for a specific energy application.	2a, 5c	The project was completed in 2018. The final report is online at https://www.energy.ca.gov/2018publications/CEC-500-2018-035/CEC-500-2018-035.pdf. The study discovered that observable large-scale patterns such as El Nino can help improve near-term predictions of wind generation. Based on future wind projections from one climate model, the team predicts that with climate change, wind power would increase during summer in most of the state and decrease during fall and winter. This study improves the characterization of uncertainty around the magnitude and variability in space and time of California's wind resources in the near future, which can reduce risk to investors and lead to greater investment in wind energy. The team communicated through three journal articles in 2018, wind investors on TAC, and an industry consultant as a project partner.
EPC-15-069 Lancaster Advanced Energy Community (AEC) Project	N/A	N/A	Yes; Calif Based Entity	Local governments can play a role in achieving California demand reduction goals by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community scale.	2a, 3b, 3e	This project concluded in March 2018. The project has resulted in a shovel-ready advanced energy community design in preparation for Phase II that includes a microgrid connecting a zero-net-energy community of 75 single-family homes for low-income residents. The project team also developed a number of resources for local governments to overcome barriers to building ZNE communities and widespread deployment of distributed energy resources. For example, they developed a financial model and policy framework for municipalities to consider land-secured financing as an option for building new residential ZNE communities. They also developed a DER valuation framework to help municipalities identify and analyze the potential value streams from community-scale deployments of solar PV, electric vehicles, battery storage, and demand response programs.
EPC-15-070 Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System	N/A	N/A	Yes; Small Business, Calif Based Entity	This project will add fine-resolution, intra-urban climate detail to coarse-scale, regional-level probabilistic or deterministic forecasting, thus allowing for more accurate, area-specific characterizations and forecasts for the electricity system and better apportionment of electricity generation.	1e	The researcher has gathered and analyzed hourly weather data from each monitoring area (Greater San Francisco Bay Area, Fresno-Bakersfield, and Los Angeles regions). The researcher also configured the Weather Research and Forecasting (WRF) atmospheric model, so the fine-resolution simulation results generated by the model can be compared with the observational data. Most recently, the researcher developed the correlations and functions to characterize and quantify intra-urban climate variability in probabilistic, short-term weather forecasts for the electric system.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-071 Zero Net Energy Farms	Market Facilitation	This project developed and piloted a Project Management Application tool for farm and agricultural communities. Included in this tool is information gathered from a trade study of available equipment vendors that will compare cost effectiveness and reliability of technologies for solar, wind, anaerobic digestion, and gasification. A unique feature about this project is that it integrated Net Energy Metering Aggregation (NEMA), a program through the California Public Utilities Commission (CPUC) that enables agricultural communities to aggregate meters in a continuous property, with various other strategies to maximize the effectiveness of the Project Management Application. Development and testing was done in collaboration with four local jurisdictions in the Central Valley, the San Joaquin Valley Air Pollution Control District, and the US Navy.	5/17/2016	No	Demand-side Management	$1,175,919	$1,175,919	$761,116	N/A	$761,116
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-072 New Chemical Compounds for Cost-Effective Carbon Capture	Applied Research and Development	This project uses computational chemistry to support the discovery and characterization of new chemical compounds that can safely and economically capture carbon dioxide (CO2) from the stacks of power plants and other large emitters.	5/17/2016	No	Generation	$200,000	$200,000	$80,947	N/A	$80,947
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-073 Identifying Effective Demand Response Program Designs to Increase Residential Customer Participation	Applied Research and Development	This project is testing the effectiveness of innovative designs for demand response programs for residential customers using a behind-the-meter customer engagement platform developed by OhmConnect. Each of these innovative demand response strategies integrates a recent approach that energy researchers have shown to be effective in reducing customer consumption. These strategies include providing households with a) tailored energy-analytic feedback, b) aggregated versus single-period incentive information, c) non-financial environmental health benefit frames and d) social comparisons. An additional strategy is exploring how the timing of the delivered demand response information affects the magnitude of household participation and response.	5/17/2016	No	Demand-side Management	$2,007,875	$2,007,875	$1,136,736	N/A	$1,136,736

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EPC-15-071 Zero Net Energy Farms	$122,540	$0	West Hills Community College District; San Joaquin Valley Air Pollution Control District; Biodico, Inc.; Office of Community and Economic Development - CSU Fresno; City of San Joaquin; Fresno Council of Governments; PondelWilkinson; Red Rock Ranch, Inc.; San Joaquin Valley Clean Energy Organization ; 18Thirty Entertainment, LLC; City of Huron; Larry Alberg; Dr. Stephen Kaffka; Chelsea Teall, PE;	$1,140,419	49.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-071 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Biodico, Inc.	Group 3: Ranked # 1
EPC-15-072 New Chemical Compounds for Cost-Effective Carbon Capture	$40,000	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-072 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Davis Campus	Group 11: Ranked # 9
EPC-15-073 Identifying Effective Demand Response Program Designs to Increase Residential Customer Participation	$203,115	$0	University of California Los Angeles; Chai Energy;	$562,633	21.9%	Grant	Pre-existing intellectual property identified in agreement EPC-15-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Regents of the University of California, Los Angeles	Group 2: Ranked # 5

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-071 Zero Net Energy Farms	N/A	N/A	Yes; Calif Based Entity	SB 350 (2015) sets a 50 percent renewable energy standard and a doubling of energy efficiency savings by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, and demand response. This project piloted innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in March 2018. The project developed an interactive tool designed for farm owners called the Zero Net Energy Farm (ZNEF) GeoPlanner, which enables users to assess the renewable energy potential of their property in meeting their specific energy needs. The ZNEF GeoPlanner enables users to estimate the cost and energy generation of various advanced energy technologies (such as solar, wind or biomass technology) geared specifically towards farms in California. An introduction to the ZNEF GeoPlanner is available at: http://www.zeronetenergyfarms.com/. Biodico used the ZNEF GeoPlanner to develop a Master Community Design at the Red Rocks Ranch in Five Points, California.
EPC-15-072 New Chemical Compounds for Cost-Effective Carbon Capture	N/A	N/A	Yes; Calif Based Entity	This project uses innovative ab initio quantum mechanical and molecular dynamics simulations to design and characterize carbon capturing compounds, mimicking processes previously discovered in plant existing in arid areas. The organic PEP compounds in these plants store and release CO2 in a similar manner as the currently used inorganic amines. Organic molecules unlike the inorganic, can be modified in a way, that would adjust their reaction enthalpy, solubility, viscosity, reaction rate to be an inexpensive, non-toxic substitute for amines in carbon capture.	2a, 4a	The research team initiated simulation and optimization of candidate carbon capturing molecules using molecular dynamics modeling tools, including the plant process simulator Cape-Open to Cape-Open (COCO). After initial computational calculations, it was realized that COCO software will not provide the level of detail needed to draw well-founded conclusions regarding the suitability of phosphoenolpyruvate (PEP) compounds for carbon capturing and sequestration. A more sophisticated plant process modeling software, Aspen Plus, has been obtained to model thermodynamics and kinetic properties of potential carbon capturing compounds. In early 2019, UC Davis in collaboration with EPRI will select the most promising compounds identified based on their calculated properties and model the carbon capture process in a typical electricity producing power plant.
EPC-15-073 Identifying Effective Demand Response Program Designs to Increase Residential Customer Participation	N/A	N/A	Yes; Calif Based Entity	This project will test the effectiveness of innovative design strategies for residential demand response providers and analyze different segments of the residential population including various socioeconomic groups and residential customers with photovoltaics and electric vehicles to see what incentives, messages and energy use information motivates reliable participation in utility demand response programs. This information will expand knowledge in this area so that utility companies and regulators can build new and modify existing demand response programs to increase effectiveness. Accurate and reliable forecasts of participation in these programs will enable better utilization of existing generation resources and deferral of system capacity upgrades thereby lowering consumer electricity costs.	1c, 1d, 1e, 1h	UCLA is working with its subcontractor, Ohm Connect, to analyze the effects of nonlinear incentives and baseline on customers and how it impacts their willingness to participate in Demand Response (DR) events. Nonlinear incentives are monetary rewards which increase exponentially with participation in DR events. The preliminary results are inconclusive which means that the data needs to be further refined with different variables. In addition, the analysis has shown that as the customer's baseline increases by 1 kWh there is an average of 0.2 kWh increase in their energy consumption during a DR event. This means customers would be more inclined to consume energy if they are given a large baseline because they would be able to get the incentive and still consume energy.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-074 Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems	Applied Research and Development	This project develops co-optimization strategies for distributed energy resources (DERs). The purpose is to maximize customer and system value under existing CPUC-approved retail and California Independent System Operator (California ISO) wholesale tariff structures, future market structures and pricing, and the transactive energy pricing signals developed under agreement EPC-15-054. The project tests and configures two DER portfolios: a) one consisting of large retail customers and schools using battery energy storage, solar photovoltaics, and integrated load management, and b) the other consisting of hotels using passive thermal energy storage, and energy efficiency. Both will be included as part of an integrated load management strategy capable of responding to price and reliability signals. The project team is also developing operational strategies for wholesale integration subject to the identified retail and wholesale tariffs and other operational constraints.	5/17/2016	No	Grid Operations/Market Design	$3,960,805	$3,960,805	$1,632,876	N/A	$1,632,876
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-075 Customer-centric Demand Management using Load Aggregation and Data Analytics	Applied Research and Development	This project demonstrates how a large number of small electric loads, each impacted by and tuned to individual customer preferences can provide load management for both utilities and the California Independent System Operator (California ISO). The primary goal is to refine and demonstrate an open-source end-use management platform capable of operating reliably with all or most available end-use devices and thus defining a viable standard protocol to which all vendors can develop new products. The recipient works with an extensive spectrum of leading product providers covering all major distributed energy resources (DERs), such as Nest (thermostats), ThinkEco (plug loads), Honda and BMW (Vehicle Grid Integration), EGuana (smart Inverter) and Ice Energy (Thermal Storage). A variety of price signals are being tested for Time-of-Use customers such as Critical Peak Pricing and Demand Rate. The project is using deep analytics to evaluate individual customer preferences for demand management using microdata from devices and aggregate the responses to meet grid needs at different distribution and transmission levels.	5/17/2016	No	Demand-side Management	$3,998,587	$3,998,587	$1,391,198	N/A	$1,391,198
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-076 Richmond Advanced Energy Community Project	Market Facilitation	This project provided technical assistance to the City of Richmond in the design and adoption of a comprehensive integrated policy and planning program, and a financing framework to facilitate adoption of advanced energy technologies needed to transform the City of Richmond into a ZNE Community. As part of this project, the project team identified unique challenges to disadvantaged communities and worked with local stakeholders, including the City of Richmond, to identify and implement specific strategies to overcome those challenges. These strategies will be piloted at the conclusion of this agreement as part of a redevelopment effort to convert 20 abandoned homes into affordable ZNE homes available for working families via the First-time Home Buyers' Program.	5/17/2016	No	Demand-side Management	$1,480,111	$1,480,111	$1,246,861	N/A	$1,246,861

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-074 Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems	$746,794	$0	Solar City Corporation; DNV GL; Conectric Networks, LLC;	$1,981,262	33.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-074 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Center for Sustainable Energy	Group 1: Ranked # 2
EPC-15-075 Customer-centric Demand Management using Load Aggregation and Data Analytics	$1,163,894	$0	Electric Power Research Institute, Inc.; InTech Energy, Inc.; Pedagogy World, Inc.;	$1,270,312	24.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1
EPC-15-076 Richmond Advanced Energy Community Project	$370,990	$0	Energy Solutions; City of Richmond; Olivine, Inc.; Richmond Community Foundation;	$2,590,134	63.6%	Grant	Pre-existing intellectual property identified in agreement EPC-15-076 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Zero Net Energy (ZNE) Alliance	Group 3: Ranked # 2

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EPC-15-074 Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems	N/A	N/A	Yes; Calif Based Entity	The project is developing and testing strategies that customers, demand response (DR) aggregators, scheduling coordinators, and policy makers can implement to provide demand response that both meets grid needs and is acceptable to customers. The project will provide comprehensive recommendations on how to overcome technical, institutional and regulatory barriers to facilitating DER participation in supply-side markets.	1c, 1d, 1e, 1f, 1g, 1h, 3e, 3f	The project is on schedule. Agreements with Solar City (recently acquired by Tesla) to engage and operate the K-12 school sites equipped with solar PV, storage, and load management control capabilities have been finalized and market participation is underway. Installation of monitoring and control equipment at the hotel sites has been completed and audits, data collection, and operational testing are already yielding recommendations for efficiency improvements. The data are being analyzed for the purpose of developing effective DR strategies. Recently, the project expanded participation to the new CAISO ancillary services market.
EPC-15-075 Customer-centric Demand Management using Load Aggregation and Data Analytics	N/A	N/A	Yes; Calif Based Entity	This project is using low cost off-the-shelf technologies to develop a platform that can manage customer end-use devices according to their preferences, minimize their energy costs, and adapt to evolving tariff structures. By making the task of automating multiple end-use devices easier, less costly, and less of an imposition on customers, the project has the potential to increase demand response participation, with consequent benefits to the electric grid.	1c, 1d, 1e, 1f, 1g, 1h, 5c	The project is on track. The team is working with their key development partners to leverage the demand response scheduling interface with the CAISO market. The recipient continues to make progress on development of their energy information database and customer user interface requirements and testing and refining the messaging across all platforms.
EPC-15-076 Richmond Advanced Energy Community Project	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving the goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project completed in 2018. The project team developed and updated several tools to help the City of Richmond roll out strategies to deploy new clean energy technologies. This included developing a rating system to streamline the City's process for evaluating projects to finance. In addition, this included enhancing the capabilities in the Green Revolving Investment Tracking System to streamline the City's administration of Green Revolving Fund and the Social Impact Bond that will be used to finance the advanced energy projects being proposed.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-077 Huntington Beach Advanced Energy Community Blueprint	Market Facilitation	This project designed an integrated energy system to transform the disadvantaged Huntington Beach community of Oak View, into an advanced energy community (AEC). The team worked closely with ComUNIDAD, a community organization, to ensure the community needs were factored into modeling scenarios. The project team developed new design tools to simulate an integrated energy infrastructure on a community-scale, expanding the capability from the existing single-building design tools. The team evaluated multiple scenarios to determine the most optimal set of clean energy technologies and business and financial models to align the community's energy needs within the constraints of the existing electricity infrastructure.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$337,423	N/A	$337,423
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-078 Risk Modeling and Cognitive Science Characterization of Barriers to Climate Change Adaptation in California Electricity Sector	Applied Research and Development	Researchers are developing a framework for assessing climate change risk and adaptation practices in the electricity sector, identifying perceived barriers to execution of resilience strategies, and delineating practices that are currently being implemented in the electricity sector. These initial activities form a basis for developing a dynamic model for long-term resilience planning that can identify optimal strategies to hedge against climate risks associated with future climate scenarios for California. The analysis also considers how independently initiated adaptation efforts perform relative to a system-wide strategy, with an eye toward identifying lingering electricity sector vulnerabilities.	5/17/2016	No	Grid Operations/Market Design	$350,000	$350,000	$177,177	N/A	$177,177
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-079 Advanced Renewable Energy Storage and Recycled Water Project	Technology Demonstration and Deployment	The Victor Valley Wastewater Reclamation Authority (VVWRA), in partnership with Primus Power, University of California Riverside (UCR), and Anaergia, is demonstrating an advanced, pre-commercial flow battery storage and control system at VVWRA's existing Regional Wastewater Treatment Plant, located in a disadvantaged community outside of Victorville. The project deploys Primus Power's ENERGYPOD flow battery system in a 240 kW/1,200 kWh configuration, managed by a UCR-designed controller system that is optimized specifically for management, generation and storage of renewable energy power. The project hopes to alleviate rapid fluctuations in the wastewater treatment plant's power demand that causes disruption of the disinfection system used to treat recycled water to California standards, resulting in the disposal of approximately 2.5 million gallons of water annually.	5/17/2016	No	Demand-side Management	$1,734,059	$1,734,059	$1,036,307	N/A	$1,036,307
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-080 Interdependencies of Electric Grid and Critical Lifelines: Identifying Climate Exposure and Adaptation Strategies	Applied Research and Development	This pilot study for electricity sector climate adaptation involves vigorous stakeholder engagement and systems analysis to identify and systematically account for cascading impacts internal to and outside of the electricity sector as well as resilience options. These cascading impacts include climate impacts to supply chains for electricity generation and distribution, disruption to telecommunications that the electricity sector relies on in emergencies, and other impacts that may be initially felt far away but have consequences for California's electricity system. One example of supply chain interruption is that manufacturing facilities in East Asia that produce 500kV transformers, which the California distribution system relies on, are susceptible to flooding and other extreme events linked to climate change. This study pilots a systematic framework for assessing such long-distance linkages that can disrupt electricity services and cause ripple or cascading effects on critical infrastructure in the Greater Los Angeles region. Findings from this project, which includes many diverse stakeholders, could be used to inform planning in other areas of the state.	5/17/2016	No	Generation	$128,188	$128,188	$128,163	N/A	$128,163

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EPC-15-077 Huntington Beach Advanced Energy Community Blueprint	$508,226	$0	Southern California Gas Company (SoCalGas); Southern California Edison; County of Orange/City of Huntington Beach; The Regents of the University of California, Irvine Advanced Power and Energy Program; National Renewable Energy Laboratory (NREL); Altura Associates, Inc.;	$810,998	35.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	The Regents of the University of California, Irvine Advanced Power and Energy Program	Group 4: Ranked # 4
EPC-15-078 Risk Modeling and Cognitive Science Characterization of Barriers to Climate Change Adaptation in California Electricity Sector	$48,887	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-078 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Berkeley	Group 8: Ranked # 1
EPC-15-079 Advanced Renewable Energy Storage and Recycled Water Project	$220,423	$0	Primus Power Corporation; Victor Valley Wastewater Reclamation Authority (VVWRA);	$902,215	34.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Victor Valley Wastewater Reclamation Authority (VVWRA)	Group 2: Ranked # 2
EPC-15-080 Interdependencies of Electric Grid and Critical Lifelines: Identifying Climate Exposure and Adaptation Strategies	$0	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-080 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Thalassa Research & Consulting, LLC	Group 11: Ranked # 3

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EPC-15-077 Huntington Beach Advanced Energy Community Blueprint	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving this goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project piloted innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	The project ended in July 2018. Using the UrbanOpt and DEROpt tools to determine the most optimal technical and economical suite of clean energy technologies, the team developed a master community design for the Oak View AEC. Because of the mild climate and limitations with aging building stock, the plan consists of the most impactful energy efficiency upgrades (lighting and plug-loads), as well as community-scale solar PV systems mounted on carports and rooftops, and energy storage. These systems were sized to reduce the overall electrical use by the maximum of nearly 94 percent. Finally, to encourage community acceptance, the team offered a ten-week STEM course to the elementary school's after-school program, and held a series of workshops to introduce residents to green energy concepts providing materials in Spanish and playing games familiar to the predominantly Hispanic community.
EPC-15-078 Risk Modeling and Cognitive Science Characterization of Barriers to Climate Change Adaptation in California Electricity Sector	N/A	N/A	Yes; Calif Based Entity	Researchers are developing methods to account for risks, plan for resulting adaptation, and account for the barriers that might exist in the system. The results of research are intended to improve on the general knowledge of framing climate-related policies under uncertainty and to examine all aspects of the adaptation planning process: decision-makers involved, stages of decision processes, and the institutional contexts where the decision-makers develop the decision processes. The results can inform technology choice investment and deployment, to the extent that those choices are made with consideration of climate risks.	1e, 2a, 3e, 3h	The research has undertaken ratepayer surveys and review of administrative documents filed with the State of California to shed light on adaptation barriers, as well as how climate-related risks have been incorporated into recent planning and decision-making processes. Additionally, the team has explored how processes associated with climate change-- such as changes in temperature and/or precipitation patterns-- could be incorporated into planning and decision-making processes through quantitative modeling. The research team is currently working to engage a TAC comprised of utilities, researchers, and other electricity sector stakeholders in review of its draft deliverables.
EPC-15-079 Advanced Renewable Energy Storage and Recycled Water Project	N/A	N/A	Yes; Calif Based Entity	The project demonstrates an advanced battery storage and control system coupled with on-site renewable energy generation and its ability to control rapid changes in on site power demands. If successful, this project could reduce grid power demand and reduce energy costs to wastewater treatment plants and alleviate disruptions in recycled water production due to high variability of on-site power loads which can cause partial treatment shutdowns. The project results could be applicable to other wastewater treatment and industrial plants in California.	1h, 3c, 4c	The recipient is running tests on the project controller and integrating with the two batteries and other components. The recipient is continuing work on the microgrid control system and onsite testing of the mechanical systems.
EPC-15-080 Interdependencies of Electric Grid and Critical Lifelines: Identifying Climate Exposure and Adaptation Strategies	N/A	N/A	None	The research will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by addressing challenges in the state's largest metropolitan area -- the study of societal teleconnections. Societal teleconnections are human-created linkages that connect activities, trends, and disruptions across large distances such that locations can experience negative impacts from faraway places. This study is producing new tools and techniques to assist communities to incorporate climate impacts that are non-local in origin into their traditional climate adaptation and hazard planning. This is the first time that a systematic approach to exogenous risks is being taken for an urban area.	2a, 3a, 3e, 3g, 4a	Drawing on extensive stakeholder engagement in 2016 and 2017 as well as interactive system modeling, researchers published a final, peer reviewed report as part of California's Fourth Climate Change Assessment. Cross-cutting findings include that energy and telecommunication are critically connected to each other and to other lifelines; emergency management and public health services depend on inputs from all lifelines to be effective; workforce availability is crucial to the ability to respond effectively, but it is already limited and dependent on many different upstream lifelines; and maintaining a state of good repair on all equipment is essential to smooth functioning of all lifelines. Opportunities to advance resilience of interdependent lifeline systems include open data policies, adaptation planning mandates, and engagement at regional levels to consider extreme scenarios.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-081 Historical Insights for Electricity Transition Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity	Applied Research and Development	Analysis of quantitative and qualitative data sheds light on histories of key energy technology changes, planned and unplanned. Interpretation of these histories will provide examples, principles and insights that can be used in future planning. The research team is producing example scenarios that illustrate the differences that these insights can make in planning and technology design. This research pays particular attention to developing and disseminating this information in usable ways, via dialogue with policy makers and planners, and through communications with other stakeholders. Leveraging insights from historical technology transitions, the research team is designing, deploying and testing a flexible modeling platform with which researchers, utilities, and Energy Commission demand modeling and forecasting staff can draw upon the best available empirical data to simulate dynamic residential demands for AC. This model serves as a proof of concept that might later be broadened to other energy uses and demand sectors.	5/17/2016	No	Grid Operations/Market Design	$400,000	$400,000	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-082 Low-Temperature Microplasma-Assisted Hydrogen Production from Biogas for Electricity Generation	Applied Research and Development	The purpose of this project is to demonstrate operation of a low-temperature microplasma reactor that will lead to an efficient, electricity-based technique to convert a mixture of carbon dioxide and methane into hydrogen for use in electricity generation. If successful, this technology could be adapted to use other gas inputs in the creation of hydrogen, such as products from the gasification of biomass.	5/17/2016	No	Generation	$200,000	$200,000	$38,380	N/A	$38,380
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-083 Empowering Proactive Consumers to Participate in Demand Response Programs	Applied Research and Development	This project contains three elements to provide data for policymakers and businesses to explore this new market. First, this project determines prosumer (producer/consumer) interest in a third-party demand response market by testing user acquisition via direct and non-direct engagement strategies. Second, experimentation with behavioral and automated users allows analysis of user yield under a variety of conditions and extract a set of shadow curves that can inform how much energy load shifting can be expected under various price incentives. Finally, this project creates a novel solution for using residential telemetry to connect prosumers and their Internet of Things (IoT) devices to the market operators.	5/17/2016	No	Demand-side Management	$3,995,028	$3,995,028	$2,738,155	N/A	$2,738,155
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-084 Total Charge Management: Advanced Charge Management for Renewable Integration	Applied Research and Development	This project explores the benefits and opportunities of Total Charge Management, where electric vehicle charging is managed across multiple charging events to maximize vehicle load flexibility. The project tests how flexible electric vehicle load can be if managed across a driver's daily or weekly charge events. This flexibility utilizes several pricing mechanisms to estimate the benefits of the Total Charge Management approach. The research develops and evaluates advanced vehicle telematics for utilities and grid operators to align vehicle battery status, driver mobility needs and grid conditions. Collaboration between the grid and the driver can yield a charging load profile that minimizes energy costs by aligning daily and weekly charging events to best meet grid needs.	5/17/2016	No	Demand-side Management	$3,999,900	$3,999,900	$1,034,708	N/A	$1,034,708

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EPC-15-081 Historical Insights for Electricity Transition Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity	$0	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-081 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Ghoulem Research	Group 11: Ranked # 4
EPC-15-082 Low-Temperature Microplasma-Assisted Hydrogen Production from Biogas for Electricity Generation	$35,171	$0	The Regents of the University of California, Merced;	$47,199	19.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Merced	Group 11: Ranked # 5
EPC-15-083 Empowering Proactive Consumers to Participate in Demand Response Programs	$33,903	$0	Honeywell, Inc.; Schneider Electric USA Inc.; OhmConnect, Inc.;	$1,877,378	32.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-083 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	OhmConnect, Inc.	Group 1: Ranked # 3
EPC-15-084 Total Charge Management: Advanced Charge Management for Renewable Integration	$207,398	$0	BMW of North America, LLC; Kevala, Inc.;	$411,931	9.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	BMW of North America, LLC	Group 1: Ranked # 1

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EPC-15-081 Historical Insights for Electricity Transition Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity	N/A	N/A	Yes; Calif Based Entity, Woman Own	Results improve the state's ability to estimate timing of technology penetration and accrual of benefits, and costs of desirable residential sector technologies. These results are key to improving the performance of efficiency measures outlined in AB 758 and the California Energy Code. They also support goals of CPUC's Energy Efficiency Strategic Plan, and inform updated estimates of timing and benefits as appropriate. Results portraying penetration and performance of key technologies (e.g., A/C) are expected to be of direct use in the scenario development and demand forecasts used in the Integrated Energy Policy Report.	5c	The research team convened in-depth discussions with members from the Energy Commission's Demand Analysis Office, Supply Analysis Office, Building Standards Office, and Research Division to ensure that their modeling and historical energy transitions efforts address needs in those areas. The research team also developed a first-cut implementation of a "Simulation Sandbox", or prototype model to enable exploration of impacts of a number of human dimensions (e.g., behavior, policy, trends in AC adoption) on residential air conditioning demand. Finally, the team has been in conversation with two utilities regarding possible partnerships involving data sharing.
EPC-15-082 Low-Temperature Microplasma-Assisted Hydrogen Production from Biogas for Electricity Generation	N/A	N/A	Yes; Calif Based Entity	Researchers will determine the appropriate operating parameters of microplasma array reactors for maximum efficiency in the biogas to syngas conversion process to produce clean electricity from renewable resources while simultaneously consuming greenhouse gases (in this case CO2), and, thereby, reducing the impact of electricity generation on the environment and climate.	2a, 4a	The research team installed and tested the low temperature microplasma reactor using a mixture of inert gases, such as argon and nitrogen, to ensure safe operation. Scientists performed experiments for plasma-assisted conversion of pure methane, pure carbon dioxide and a 50/50 mixture of methane and carbon dioxide. The researchers analyzed gaseous products of conversion process using gas chromatograph. Future and on-going experiments for different CO2/CH4 ratios will help to better understand factors influencing conversion rate and selectivity.
EPC-15-083 Empowering Proactive Consumers to Participate in Demand Response Programs	N/A	N/A	Yes; Calif Based Entity	This project is providing critical evidence that residential customers are willing to manage their electric loads for the purpose on meeting grid needs when presented with the meaningful, actionable information and salient incentives. The approach makes use of multiple social media platforms for communication and has developed multiple virtual customer "experience" opportunities using those platforms that enhance participation and keep customers interested and involved. The project provides conclusive evidence that with the appropriate approach, residential customers can and will adapt their energy use to a grid that depends heavily on variable renewable generation. This evidence can be used to help policymakers and regulators develop more effective direction for utility tariff and program design as well as program parameters for third party aggregator participation in demand response.	1c, 1d, 1e, 1f, 1g, 1h, 3e	This project is on track. Over 450,000 utility customers have signed up with OhmConnect, and about 35,000 of those participated in the experimental treatments conducted under the EPIC grant. The recipient completed the work to incorporate numerous different transactive signals, including the utility, the CAISO, and EPRI. The recipient has completed the preliminary data modeling and has been successfully bidding into and winning contracts to provide DR to the CAISO when dispatched through the Demand Response Auction Mechanism. The draft final report is anticipated in December 2018 and the project is on track for completion in the first quarter of 2019.
EPC-15-084 Total Charge Management: Advanced Charge Management for Renewable Integration	N/A	N/A	Yes; Calif Based Entity	This project will help the state advance the flexibility of electric vehicle charging as a flexible grid resource and vehicle charging cost savings to the driver. Optimal charging load patterns will be identified that can capture ratepayer and grid benefits using a variety of grid price signals. The project will pioneer demand response and smart charging technology advancement of not only the temporal benefits of controlled charging, but also the possible benefits that can be derived from being able to influence the location of charging.	1g	BMW optimized their smart charging using grid pricing and constraints tests for residential night time charging with 50 drivers, which will guide the expansion to away-from-home charging and daytime charging (locational marginal pricing and renewable generation). Kevala (subcontractor) developed and integrated a tool to identify the subLAP (sub-load aggregation point) and LMP node locations to facilitate vehicle charging management when vehicles are away from home. BMW identified, permitted, and installed four energy storage systems to begin implementing the energy storage and combined use cases. The project team completed a distribution constraint analysis to inform use case implementations in 2018. BMW presented a project overview, methodology, and preliminary results to partners in Europe.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-085 San Diego Libraries Zero Net Energy and Integrated Demand Side Management Demonstration Project	Technology Demonstration and Deployment	This project is a partnership with the city of San Diego to bring ZNE to three libraries. It integrates pre-commercial energy efficiency measures, building automation, control systems, and behind the meter solar photovoltaic to retrofit three existing public libraries in San Diego.	6/14/2016	No	Demand-side Management	$2,715,516	$2,715,516	$755,233	N/A	$755,233
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-086 Substation Automation and Optimization of Distribution Circuit Operations	Applied Research and Development	This project will develop a Generic Microgrid Controller (GMC) to allow electrical substation control over grid assets, including generation resources, energy storage, and controllable loads. This will improve grid management at the distribution level. The team will assess different tariffs and interconnection agreements for a portfolio of scenarios to address the participation of DERs in the market. In addition, a fictitious retail/distribution market will be developed and assessed.	6/14/2016	No	Distribution	$932,718	$932,718	$592,300	N/A	$592,300
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-087 Cooling Tower Water Treatment using Vortex Process Technology for Energy and Water Savings	Technology Demonstration and Deployment	This agreement is funding the full-scale deployment demonstration of the Vortex Process Technology in cooling towers of commercial buildings. This technology has been used successfully in Europe and will be testing in California to address state specific goals for water and energy savings.	6/14/2016	No	Demand-side Management	$1,999,995	$1,999,995	$1,085,309	N/A	$1,085,309
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-088 Biofiltration as an Advanced Primary Treatment Method to Achieve Substantial Energy Savings	Technology Demonstration and Deployment	The project is demonstrating that Biofiltration is a technically viable and commercially attractive approach to achieve significant electrical energy savings at wastewater treatment plants. This project is quantifying the electrical energy reduction and water savings that can be achieved by Biofiltration based on demonstration results at the Linda County Water District plant. This project will provide the cost and performance data to evaluate the benefits from a sustained, full scale validation testing, including quantification of electrical energy savings, determination of water savings, organic solids removal efficiencies, operation and maintenance and design criteria, independent monitoring and verification and technology transfer.	6/14/2016	No	Demand-side Management	$1,306,185	$1,306,185	$340,641	N/A	$340,641
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-089 Expanding Standards and Developing Tools to Enable DNP3 Support of Energy Storage Use Cases	Applied Research and Development	The recipient is developing tools to make adoption of DNP3 for communication and control of energy storage systems simple and seamless. The approach is to evaluate the current state of communications to DERs and address any gaps in functionality, work with the DNP3 Users Group to update the existing energy storage and solar specifications to support the most advanced energy storage use cases, create an open-source DNP3 client to simplify product development of smart inverters, and develop the appropriate conformance testing tools to ensure interoperability.	6/14/2016	No	Distribution	$873,516	$873,516	$440,161	N/A	$440,161

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-085 San Diego Libraries Zero Net Energy and Integrated Demand Side Management Demonstration Project	$313,516	$0	San Diego Gas and Electric Company; City of San Diego; San Diego Green Building Council;	$543,568	16.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Center for Sustainable Energy	Group 5: Ranked # 1
EPC-15-086 Substation Automation and Optimization of Distribution Circuit Operations	$124,021	$0	The Regents of the University of California, Irvine Advanced Power and Energy Program; OPAL-RT Corporation;	$112,281	10.7%	Grant	Pre-existing intellectual property identified in agreement EPC-15-086 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Advanced Power and Energy Program (APEP) - University of California, Irvine	Group 2: Ranked # 2
EPC-15-087 Cooling Tower Water Treatment using Vortex Process Technology for Energy and Water Savings	$485,121	$0	Electric Power Research Institute, Inc.; Cypress LTD;	$449,990	18.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-087 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 6
EPC-15-088 Biofiltration as an Advanced Primary Treatment Method to Achieve Substantial Energy Savings	$442,698	$0	Kennedy/Jenks Consultants; Linda County Water District; WesTech, Inc.; Professor George Tchobanoglous, Ph.D., P.E. ;	$271,750	17.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Kennedy/Jenks Consultants	Group 2: Ranked # 1
EPC-15-089 Expanding Standards and Developing Tools to Enable DNP3 Support of Energy Storage Use Cases	$187,517	$0	Electric Power Research Institute, Inc.; Xanthus Consulting International; SunSpec Alliance; MESA Standards Alliance;	$360,828	29.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-089 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 3

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-085 San Diego Libraries Zero Net Energy and Integrated Demand Side Management Demonstration Project	N/A	N/A	Yes; Calif Based Entity	Combining energy efficiency and building automation with solar photovoltaics can result in an integrated approach capable of meeting the state's energy efficiency goals and providing demand response to provide grid flexibility. As the commercial sector, and local governments in particular, are risk averse, being able to demonstrate an integrated approach as well as document performance, benefits, and costs without disrupting municipal operations is key to encouraging greater adoption of the technologies. The successful implementation of technology will help other local governments and the commercial building industry budget, plan and prioritize these types of projects for existing building ZNE upgrades leading up to the state's 2030 requirements.	1e, 1f, 1h	Baseline energy monitoring has been completed for all three library sites. The PV system was installed at all library sites. Work is underway to identify the energy efficiency measures to be installed at the three library sites. Installation is expected to be completed by June 2019.
EPC-15-086 Substation Automation and Optimization of Distribution Circuit Operations	N/A	N/A	Yes; Calif Based Entity	This Agreement will lead to technological advancement and breakthroughs by developing a control strategy to manage high penetrations of distributed energy assets (including generating resources, energy storage and controllable loads) as a single unit at a substation. The GMC will manage dispatchable loads and generation, reducing stress on the grid by shedding unnecessary loads and dispatching generation as required. The GMC also includes an economic dispatch feature that determines the least expensive solution to serve all the loads.	1g, 3a, 3f, 5f	Recipient invoices quarterly, anticipate next invoice to improve net paid.
EPC-15-087 Cooling Tower Water Treatment using Vortex Process Technology for Energy and Water Savings	N/A	N/A	Yes; Calif Based Entity	Non-chemical water treatment has the potential to reduce water use, improve quality of water discharged to wastewater stream, reduce scaling in condenser water piping, and increase energy efficiency of chilled water plants. The Vortex technology removes calcium carbonate from recycled cooling water and improves viscosity. By removing calcium carbonate physically it reduces the amount of chemicals used in calcium removal methods.	1f, 1h, 4c, 4d, 4e	The Vortex Process Technology (VPT) has been installed and operational at both host sites with continued data collection and monitoring. Significant water savings are being achieved at both sites as the cooling tower cycles of concentrations are increased. In the case of Amgen, the Cycles of Concentration (the makeup water and blowdown water per unit of cooling) have increased from 3.4 prior to the VPT system installation to 7.0, which resulted in savings of 18% in makeup water from Aug 2017 to July 2018. The two sites are Amgen in Thousand Oaks, CA and The Westin Hotel in Rancho Mirage, CA. Preliminary analysis shows 2.5 - 4 percent energy savings at the Amgen site.
EPC-15-088 Biofiltration as an Advanced Primary Treatment Method to Achieve Substantial Energy Savings	N/A	N/A	Yes; Calif Based Entity	Biofiltration as an advanced primary treatment method could reduce the aeration electrical energy needed for secondary treatment, increase energy production in the anaerobic digester from the removed organic material and increase existing secondary treatment capacity and forestall the need for future treatment plants. Based on pilot studies outside of California, Biofiltration has the potential to decrease aeration power by 45 to 60 percent, increase gas production from 25 to 40 percent and increase treatment capacity by 50 percent.	1f, 1h, 4c	Kennedy/Jenks completed installation in July 2018 and have been operating the biofilter at the Linda County Water District site. They are currently working on updating the electrical work for alarms and controls.
EPC-15-089 Expanding Standards and Developing Tools to Enable DNP3 Support of Energy Storage Use Cases	N/A	N/A	Yes; Calif Based Entity	This project will advance the DNP3 protocol (communication standards for smart inverters) by making it simple and seamless while also improving communications with stand-alone energy storage systems and control of other inverter-based devices. This will allow California to utilize more energy storage systems; thus, increasing the use of renewables and other DERs to support a more flexibility grid.	1a, 1h, 1i, 2a, 3a, 5a	The team solicited input from a 150+ person international advisory group representing utilities, manufacturers, and researchers to identify gaps in the protocol for energy storage. The project team then developed coding to help address the gaps and applied the newly identified coding to the existing protocol used by utilities to control large scale storage systems. Additionally, the updated protocol was finalized in August 2018. The team is currently performing conformance testing with other standards and will streamline the adoption of this update through tech transfer, open source tools, and compliance testing.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-090 Integrated Distributed Energy Resources Management System (iDERMS)	Applied Research and Development	This project is developing an Integrated Distributed Energy Resource Management System (iDERMS) to coordinate the operation of a large number of DERs. In normal grid operations, the system would aggregate multiple DERs consisting of flexible loads, renewable resources, and energy storage systems. The DERs would be coordinated to optimize power flow and respond to a distribution system operator electricity market. In an emergency situation, the system would provide any needed reactive power support to the distribution grid with smart inverters. Additionally, the system would coordinate DERs on the distribution system to help restore the grid in the event of an outage.	6/14/2016	No	Distribution	$1,119,437	$1,119,437	$346,348	N/A	$346,348
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-091 Energy Efficiency and Water Savings in Agriculture by Innovative Plant-Aware Irrigation System	Technology Demonstration and Deployment	This project addresses the specific problem of fixed watering schedules for agricultural crops by demonstrating a new irrigation system that saves both water and energy. This system performs on the principle that crops are watered only when needed, and not just on a set time-interval. The additional benefits of this system are the improved quality and yield of the crop. The goals of this project are to demonstrate the Plant Aware Irrigation (PAI) system on perennial crops, quantify the energy and water savings, and engage customers' feedback of perceived benefits while acknowledging their concerns. The technology is being demonstrated in three vineyards.	6/14/2016	No	Demand-side Management	$1,097,990	$1,097,990	$146,675	N/A	$146,675
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-092 Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal	Technology Demonstration and Deployment	The project is demonstrating a biofiltration system that uses 15-20 percent less energy when compared to conventional technology used to treat contaminated water to meet drinking water standards or for use in industrial and/or agricultural applications. The technology is being demonstrated in the City of Barstow and the focus is removal of nitrate, perchlorate and turbidity from the wastewater. The project includes water testing to secure Conditional Acceptance as a Title 22 drinking water treatment technology from the State Water Resources Control Board.	6/14/2016	No	Demand-side Management	$1,722,072	$1,722,072	$1,302,662	N/A	$1,302,662
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-093 Accelerating Drought Resilience Through Innovative Technologies	Market Facilitation	This project compiled data from county utilities to find what industries had the highest energy impact during the drought. Then, the project provided input on what water-energy technologies would lessen the impact during future droughts. Finally, the team assisted local jurisdictions in implementing strategies and measures that reduce development times and costs, as well as recommended innovative financing mechanisms and cutting edge water-energy technologies. The recipient piloted the model for Tulare County in an effort to develop a roadmap for implementation of the model in other similar rural agricultural communities.	6/14/2016	No	Demand-side Management	$1,000,000	$1,000,000	$999,376	N/A	$999,376
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-094** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	Technology Demonstration and Deployment	This project is demonstrating cost-competitive ZNE design strategies that combine occupant needs with technology solutions to create new pathways for residential ZNE communities. The strategies will be demonstrated in single and multifamily buildings. The project's goals are cost effectiveness for the customer, affordability, overcoming customer apprehension, establishing a track record of new technology for builders, enabling distribution grid integration, creating a planning process for ZNE communities, evaluating community solar and evaluating the impact of future changes to ZNE cost effectiveness. This project also aims to understand the operation and energy use of the unregulated loads.	6/14/2016	No	Demand-side Management	$3,207,432	$3,207,432	$469,224	N/A	$469,224

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-090 Integrated Distributed Energy Resources Management System (iDERMS)	$77,873	$0	University of California, Riverside; PetaPower, Inc.;	$530,392	32.1%	Grant	Pre-existing intellectual property identified in agreement EPC-15-090 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	The Regents of the University of California (UC Riverside)	Group 2: Ranked # 1
EPC-15-091 Energy Efficiency and Water Savings in Agriculture by Innovative Plant-Aware Irrigation System	$307,688	$0	Fruition Sciences;	$331,000	23.2%	Grant	Pre-existing intellectual property identified in agreement EPC-15-091 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 4
EPC-15-092 Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal	$0	$0	MWH; City of Barstow; Tomorrow Water dba BKT United; Kana Engineering Group, Inc.; Khalil Kairouz Consulting; Eurofins Eaton Analytical;	$417,497	19.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-092 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Tomorrow Water dba BKT United	Group 2: Ranked # 3
EPC-15-093 Accelerating Drought Resilience Through Innovative Technologies	$178,824	$0	Synergy, Inc.;	$5,000	0.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-093 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Water Energy Innovations, Inc.	Group 3: Ranked # 1
EPC-15-094** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	$1,460,838	$0	Electric Power Research Institute, Inc.; LINC Housing Corporation; Fresno Housing Authority;	$1,109,482	18.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-094 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Electric Power Research Institute, Inc.	Group 6: Ranked # 2

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-090 Integrated Distributed Energy Resources Management System (iDERMS)	N/A	N/A	Yes; Calif Based Entity	The project will develop controls to create virtual generators by aggregating DERs. The aggregated virtual generators would be capable of providing energy shifting, frequency regulation, and flexible ramping services to mitigate the uncertainties brought by renewable generation. The iDERMS has the potential to increase renewable penetration, reduce GHG emissions and make virtual generators cost competitive with centralized power plants.	1g, 3a, 3f, 5a	No issues. Just had a successful technical briefing from team on the last of the three software modules. The project is on time and budget. The team met with SoCal Edison's distribution system operator group on August 27, 2018 in Rosemead. The Edison group has shown interest in using the final product.
EPC-15-091 Energy Efficiency and Water Savings in Agriculture by Innovative Plant-Aware Irrigation System	N/A	N/A	Yes; Calif Based Entity	The technology being demonstrated precisely detects when crops need water, triggering irrigation only when needed. Delivering less water reduces pumping and the associate energy use, lowering GHG emissions. Expanded deployment to other California perennial fruit crops has the potential to save significant amounts of energy and water, moving the state closer to its energy goals.	1f, 1h, 3g, 4a, 4c	Sap sensors were installed at vineyards and measurement data was collected. The project was delayed due to wild fires and site changes. This affected some of the data collection but should not affect the final report. The sensors were removed for grape harvest season and watering is typically discontinued from December through June. The recipient is evaluating the data, starting the final report outline, and conducting technology transfer activities, such as disseminating information to the Almond Board and the utilities. The draft final report is anticipated in May 2019.
EPC-15-092 Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal	N/A	N/A	Yes; Calif Based Entity, Minority Owned	The project is anticipated to offer a lower energy alternative for treatment of the most common contaminants preventing use of ground water resources in California. The project could enable the development of new water supplies in many of the drought challenged regions of the State. Local treatment of impaired groundwater will provide additional energy benefits by eliminating the cost associated with transporting clean water from distant sources. The biofiltration treatment technology has the potential of efficiently treating contaminated water in an energy efficient manner while generating no waste brine.	1f, 4a, 4d	The Recipient finished the acclimation process to introduce microorganisms for colonization of the bioreactor. The biofiltration system is operating in continuous mode; it was previously running in batch mode as the Regional Water Board had concerns over the perchlorate concentration. The Recipient is now focusing on determining the minimum contact time of water to treatment medium required to achieve nitrate and perchlorate removal below CA's Maximum Contaminant Levels and optimizing the chemical injection system to determine minimum acetic acid concentration. Electricity data will be collected at the main submeter for the biofiltration system and compared to the baseline to calculate savings.
EPC-15-093 Accelerating Drought Resilience Through Innovative Technologies	N/A	N/A	Yes; Small Business, Calif Based Entity, Minority Owned, Woman Own	This project will develop a comprehensive regional drought resilience plan that will match high potential energy and water efficiency technologies with potential adopters. This will lead to greater reliability and drought resiliency while reducing agricultural energy demand.	3e, 4c	This project completed in October 2018. The project identified specific technology solutions and strategies that Tulare County and similar communities can use to build drought resilience while also supporting electric reliability and reducing greenhouse gas emissions. A model Drought Resilient Technologies Program, developed by the project, is embodied in the Drought Resilient Toolkit (http://droughtresilience.com/). This project found that most drought resilient opportunities involve actions and investments by water users, and that significant draught resilient in Tulare County could be achieved by implementing just the following solutions: convert flood to drip irrigation, recycle/reuse food processing water, and accelerate change outs to water efficient fixtures.
EPC-15-094** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	N/A	N/A	Yes; Calif Based Entity	This research will provide new methodologies for integrating occupant and technology needs into a cost effective and scalable zero net energy (ZNE) strategy. The project will analyze and define the savings and market barriers in residential communities and provide new, valuable performance data and models from the demonstrations. The products from this research will be essential to identifying the successes and barriers to meeting the ZNE goals for residential communities.	1f, 1h, 2a, 4a	All project demonstration sites were changed due to prevailing wage issues and a one year time extension was approved to allow time for the required M&V after occupancy. The four sites include construction of new single family homes in Belmont, and multifamily units in Compton, Fresno and Pomona. The research team is currently investigating potential upgrades for battery technologies, performance walls, lighting, and water heating technologies. The buildings are expected to complete construction in 2019.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-094** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	Technology Demonstration and Deployment	This project is demonstrating cost-competitive ZNE design strategies that combine occupant needs with technology solutions to create new pathways for residential ZNE communities. The strategies will be demonstrated in single and multifamily buildings. The project's goals are cost effectiveness for the customer, affordability, overcoming customer apprehension, establishing a track record of new technology for builders, enabling distribution grid integration, creating a planning process for ZNE communities, evaluating community solar and evaluating the impact of future changes to ZNE cost effectiveness. This project also aims to understand the operation and energy use of the unregulated loads.	6/14/2016	No	Demand-side Management	$1,735,377	$1,735,377	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-096 Demonstrating Innovative Leakage Reduction Strategies: Correlating Continuous Acoustic Monitoring, Satellite Imagery and Flow Sensitive Pressure Reducing Valve System	Technology Demonstration and Deployment	This project is demonstrating three leak detection technologies to reduce the amount of water lost from leaks and the amount of embedded energy wasted due to these leaks. The technologies tested include satellite imagery leak detection, correlating continuous acoustic monitoring, and flow sensitive pressure reducing valves. These technologies have site demonstrations in four Southern California cities. The Recipient will present achievable and measurable water savings in water distribution systems and show the potential for water and energy savings. An economic analysis of the costs and benefits of the technologies will be developed to assist in considering solutions for water loss reduction and energy efficiency. The project benefits will be quantified through water saved, embedded energy saved and associated greenhouse gas emissions reduced.	6/14/2016	No	Demand-side Management	$1,517,780	$1,517,780	$1,106,278	N/A	$1,106,278
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-097 Achieving Zero Net Energy in Multi-family Buildings	Applied Research and Development	This project demonstrates the potential of breakthrough electric water heating and space conditioning technologies as a pathway to zero net energy. The project explores the complex, interdependent systems in multifamily buildings and how they work together to achieve zero net energy status for the buildings in a cost-effective manner. Four multifamily buildings, designed to be affordable, are to be evaluated in various stages of design and development. These buildings share a goal of all electric zero net energy construction with 100 percent renewable energy generation, and utilize innovative new heat pump technologies to serve the buildings water heating and/or space conditioning needs.	6/14/2016	No	Demand-side Management	$1,955,811	$1,955,811	$931,714	N/A	$931,714
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-001 Measure Results from Affordable Zero Net Energy Homes	Applied Research and Development	The project implements lessons learned from previous high performance housing research and measures the results in two new homes being built in partnership with Habitat for Humanity in a disadvantaged community in Stockton. Both houses include advanced architectural design features, high performance enclosures, advanced heating, ventilating and air conditioning systems, and low-cost water heating systems. One all-electric home and one mixed fuel (combined electric and natural gas) home is being built to demonstrate the respective cost-effectiveness of each set of features. In addition to measuring actual performance of occupied houses, the project is developing a guide to affordable residential zero net energy design and construction along with a training curriculum, and will offer training opportunities based on the project results.	7/13/2016	No	Demand-side Management	$1,000,000	$1,000,000	$281,319	N/A	$281,319

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-094** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	$0	$0	Electric Power Research Institute, Inc.; LINC Housing Corporation; Fresno Housing Authority;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-094 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Electric Power Research Institute, Inc.	Group 6: Ranked # 2
EPC-15-096 Demonstrating Innovative Leakage Reduction Strategies: Correlating Continuous Acoustic Monitoring, Satellite Imagery and Flow Sensitive Pressure Reducing Valve System	$222,664	$0	Hazen and Sawyer; American Water Works Company, Inc.; Echologics;	$391,461	20.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-096 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	American Water Works Company, Inc.	Group 2: Ranked # 7
EPC-15-097 Achieving Zero Net Energy in Multi-family Buildings	$0	$0	Resources for Community Development; Corporation for Better Housing;	$290,090	12.9%	Grant	Pre-existing intellectual property identified in agreement EPC-15-097 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Build It Green	Group 2: Ranked # 2
EPC-16-001 Measure Results from Affordable Zero Net Energy Homes	$325,815	$0	Southern California Gas Company; Dettson;	$168,500	14.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Institute of Gas Technology dba Gas Technology Institute	Group 2: Ranked # 1

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EPC-15-094** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	N/A	N/A	Yes; Calif Based Entity	This research will provide new methodologies for integrating occupant and technology needs into a cost effective and scalable zero net energy (ZNE) strategy. The project will analyze and define the savings and market barriers in residential communities and provide new, valuable performance data and models from the demonstrations. The products from this research will be essential to identifying the successes and barriers to meeting the ZNE goals for residential communities.	1f, 1h, 2a, 4a	All project demonstration sites were changed due to prevailing wage issues and a one year time extension was approved to allow time for the required M&V after occupancy. The four sites include construction of new single family homes in Belmont, and multifamily units in Compton, Fresno and Pomona. The research team is currently investigating potential upgrades for battery technologies, performance walls, lighting, and water heating technologies. The buildings are expected to complete construction in 2019.
EPC-15-096 Demonstrating Innovative Leakage Reduction Strategies: Correlating Continuous Acoustic Monitoring, Satellite Imagery and Flow Sensitive Pressure Reducing Valve System	N/A	N/A	None	This project will advance the technical knowledge of detecting and preventing underground water leaks and estimating the energy savings associated with the water leak detection/prevention strategies. Identifying and demonstrating tools to help water agencies monitor, assess and manage their water distribution systems conserves water resources, increases water system reliability, lower emergency and repair costs and reduces water and electricity costs for ratepayers. These benefits will be quantified through the volume of water saved and the embedded energy in the saved water.	4c	At the City of Duarte test site, Utilis (the Satellite Imagery subcontractor) and Echologics have begun operations in detecting leaks and repairing them. At the City of Ventura site, flow monitors are being installed in various locations for baseline monitoring. At the City of Coronado site, the project team is monitoring the site for leaks with the flow sensitive pressure reducing valves. Monitoring at each site will occur for a period of 12 months.
EPC-15-097 Achieving Zero Net Energy in Multi-family Buildings	N/A	N/A	Yes; Calif Based Entity	The project demonstrates the technical and economic feasibility of zero net energy design for large multifamily projects and establishes design and installation best practices that minimize risks for developers. This includes documentation of best practices to ensure that energy and cost benefits of zero net energy are fully realized and identified, including the trade-offs between technology solutions, capital costs, operating and maintenance costs, environmental benefits and grid impacts.	1f, 1h	This project is on track. The construction of all four multifamily buildings in Sunnyvale, Atascadero, Cloverdale and Calistoga is now complete. The installation of domestic hot water monitoring devices such as meters, data loggers and sensors were completed for all buildings in 2018. Energy display installations, which uses colors to inform occupants in real time how much energy is being consumed, will be completed in all sites by March 2019. In 2019, all data collected on DWH, thermal storage, HVAC, systems performance, electrical consumption, occupancy behavior will be analyzed to determine technical and cost effectiveness and how close each building is achieving Zero Net Energy status . The monitoring period will be completed in May of 2020.
EPC-16-001 Measure Results from Affordable Zero Net Energy Homes	N/A	N/A	None	The technological advancement in this project is to utilize innovative construction approaches that couple advanced energy efficiency measures with integrated project design and delivery (IPD) in a cost-effective manner. These approaches aim to reduce structural framing to minimize heat paths through the walls, improve wall and attic insulation, increase equipment efficiency, reduce air infiltration levels, and improve water heater and HVAC performance. The approaches will emphasize minimum energy use, high indoor air quality, robust and appealing architectural design, solid structural integrity, and practical, low cost construction. If successful, these innovative approaches could become standard construction practice leading to widespread deployment of affordable ZNE homes.	1e, 1f, 1h, 2a	Progress this year includes getting stakeholder feedback through technical advisory meetings to finalize pilot test design details, completing the pilot test monitoring plan deliverable, obtaining permits for the two pilot test homes, completing the mid-term benefits questionnaire, conducting outreach activities such as presenting on research efforts at the 2018 American Council for an Energy-Efficient Economy (ACEEE) Summer Study, initiating construction of the pilot homes, and developing two chapters of a book that will help educate and inform the larger builder community about affordable ZNE design. Habitat for Humanity has hired additional staff to expedite construction efforts in 2019.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-002 Pathways to More Cost-Effective ZNE Homes	Applied Research and Development	This study provides detailed cost-effectiveness modeling of all electric, Zero Net Energy (ZNE) homes compared to mixed-fuel ZNE homes with gas-based heating. Evaluation includes costs of building integration, energy efficiency packages, installed equipment, and lifetime investment costs. The project provides spatial and temporal analyses to enable an assessment of cost-effectiveness in four California climate zones. This information will help policy makers better understand the cost and benefit tradeoffs of ZNE policy - and allow for more informed planning to reach ZNE targets in 2020 and 2030. It will also provide the information on the climate trade-offs of all electric homes compared to those with electric and gas service.	7/13/2016	No	Demand-side Management	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-003 Pilot-Scale Evaluation of an Integrated Building Control Retrofit Package	Applied Research and Development	This project tests an integrated building control package that maximizes energy efficiency for existing commercial buildings. The project refines novel control algorithms that utilize shared device state and environmental data for lighting, fenestration and heating, ventilating and air conditioning (HVAC) systems. Sharing data from multiple device types will further improve overall, sustained, system performance and operation. Control algorithms prioritize lighting or heating/cooling savings based on climate and building design. HVAC system management leverages passive ventilation through windows and skylights and dynamic adjustment of HVAC set point dead bands.	7/13/2016	No	Demand-side Management	$1,999,089	$1,999,089	$517,298	N/A	$517,298
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-004 Integrated Whole-Building Zero Net Energy Retrofits for Small Commercial Offices	Applied Research and Development	This project develops and evaluates cost-effective packages of pre-commercial integrated energy efficiency measures and controls to achieve zero net energy (ZNE) performance for small commercial offices in California. The project team is utilizing Lawrence Berkeley National Laboratory's FLEXLAB to test whole-building integrated systems under varied climate and use conditions, with additional testing to be conducted at a retrofitted office building in Berkeley, CA. The team is aiming to achieve a minimum of 50 percent energy savings over baseline conditions at the retrofit site to achieve ZNE. Data on energy, occupant comfort, and occupant behavior are being analyzed to identify best practices that can be replicated elsewhere in the State.	7/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$1,560,556	N/A	$1,560,556
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-005 Energy Efficient HVAC Packages for Existing Residential Buildings	Applied Research and Development	This project demonstrates innovative pre-commercial, cost-effective retrofit packages for cooling and ventilation for single family homes. Energy savings, occupant behavior and indoor air quality (IAQ) are to be measured for two specific retrofit packages that each includes three innovative technologies: (1) building envelope sealing, (2) two variants of smart mechanical ventilation that include pre-cooling strategies, and (3) mostly compressor-free evaporative air-conditioning. Furthermore, barriers and opportunities towards adoption of such retrofits are to be identified through stakeholder interviews.	7/13/2016	No	Demand-side Management	$1,200,000	$1,200,000	$180,715	N/A	$180,715
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-006 Low Energy, Zero Liquid Discharge Adsorption Technology to Remove Contaminants and Recover Source Water	Applied Research and Development	The project is testing an innovative, low energy, zero liquid discharge water treatment system using adsorption process to potentially remove arsenic and other contaminants from a groundwater reservoir. The project is developing a demonstration-scale water treatment system to determine operational costs, energy and water savings of the single use adsorption system The demonstration will validate the reduction in spent adsorption media by natural dehydration to further save energy and water associated with residual solid waste handling. The project includes testing and reporting to secure state mandated acceptance of the novel drinking water treatment technology.	7/13/2016	No	Demand-side Management	$986,262	$986,262	$317,540	N/A	$317,540

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EPC-16-002 Pathways to More Cost-Effective ZNE Homes	$436,541	$0	Lawrence Berkeley National Laboratory;	$50,000	4.8%	Grant	Pre-existing intellectual property identified in agreement EPC-16-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 1
EPC-16-003 Pilot-Scale Evaluation of an Integrated Building Control Retrofit Package	$392,705	$0	Regents of the University of California, Davis - California Lighting Technology Center;	$263,927	11.7%	Grant	Pre-existing intellectual property identified in agreement EPC-16-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Regents of the University of California, Davis - California Lighting Technology Center	Group 1: Ranked # 4
EPC-16-004 Integrated Whole-Building Zero Net Energy Retrofits for Small Commercial Offices	$706,115	$0	Northern California test site partner ;	$2,000,000	50.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 1
EPC-16-005 Energy Efficient HVAC Packages for Existing Residential Buildings	$366,421	$126,000	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Regents of the University of California, Davis	Group 1: Ranked # 3
EPC-16-006 Low Energy, Zero Liquid Discharge Adsorption Technology to Remove Contaminants and Recover Source Water	$0	$0	ES Engineering Services, LLC; Khalil Kairouz Consulting; Enova Water LLC; AQUAlity Engineering, Inc.; Municipal Management Group, Inc.;	$194,904	16.5%	Grant	Pre-existing intellectual property identified in agreement EPC-16-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	ES Engineering Services, LLC	Group 1: Ranked # 4

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EPC-16-002 Pathways to More Cost-Effective ZNE Homes	N/A	N/A	Yes; Calif Based Entity	The project identifies key cost-reduction opportunities to inform future policy decisions and includes development of cost data on photovoltaic cost reduction potential, building shell measures, and future end-use appliance costs and performance and estimates of cost sensitivities of various ZNE related issues. The latter includes offsite renewable energy procurement, climate impacts, and policy levers, such as mortgage tax credits and incentives.	1f, 1h, 4a	The project is currently ahead of schedule. The team has briefed the Energy Commission staff on some of its results, and continues to finalize some modeling scenarios with feedback provided during those meetings. Preliminary results identified cost-effective approaches to ZNE construction for both mixed-fuel and all-electric homes. Staff will work on the final report in early 2019.
EPC-16-003 Pilot-Scale Evaluation of an Integrated Building Control Retrofit Package	N/A	N/A	Yes; Calif Based Entity	This project seeks to improve sensor-controlled lighting and air conditioning systems by integrating and sharing information from multiple sensors, resulting in better quality indoor spaces with reduced energy cost. This research will focus on refinement and testing of an Integrated Building Control Retrofit Package. The includes the refinement of novel control algorithms that utilize shared device state and environmental data among lighting, fenestration and HVAC devices.	1f, 1h, 3e	The testing site for this project was switched from the Rifle Range to the Barn, both office type buildings on the campus of UC Davis. In 2019, the team will install the integrated control system at the site to test real operating conditions. Currently, the team is testing the system.
EPC-16-004 Integrated Whole-Building Zero Net Energy Retrofits for Small Commercial Offices	N/A	N/A	Yes; Calif Based Entity	This project develops and validates integrated whole building retrofit packages using pre-commercial underutilized technologies and controls with the goal of reducing energy use in small commercial offices by at least 50 percent. The project also aims to increase system reliability by reducing peak energy loads and potentially supporting automated demand response implementation. The energy efficiency and demand reduction components of the project provide a path towards meeting the State's energy efficiency and climate goals along with a means to replicate these strategies.	1e, 1f, 1h, 2a, 4a	Progress this year includes ZNE package development, initiating and completing FLEXLAB testing, finalizing ZNE retrofit site design and measurement plan, and getting stakeholder feedback through technical advisory committee meetings. LBNL is working closely with the City of Berkeley to complete the office building retrofit to achieve ZNE with construction scheduled to be completed in 2019.
EPC-16-005 Energy Efficient HVAC Packages for Existing Residential Buildings	N/A	N/A	Yes; Calif Based Entity	To address the current issues with indoor air quality and energy efficiency in existing homes, this project will demonstrate and evaluate two residential retrofit packages that incorporate advanced technologies for achieving both of these goals. Better envelope tightness combined with a dedicated ventilation system and highly efficient evaporative cooler will increase indoor air quality, reduce energy use for air conditioning and reduce overall peak demand. Additionally, the project could increase comfort for building occupants and reduce energy costs for building owners.	1f, 1h, 2a	One year of baseline monitoring has been completed and currently awaiting the installation of the Smart Vent and Night Breeze systems along with the sub wet bulb evaporative cooling (SWEC) and DX coil. Two similar but unique retrofit packages will be installed starting in December 2018. Once installed then post monitoring will start in early June 2019. Both sites will receive aerosol envelope sealing, and a sub wet bulb indirect evaporative cooling (IDEC) with a fresh air vent system. A small add-on direct expansion coil will be added to each IDEC unit to allow for extra cooling during limited high summer temperatures. Indoor air quality is also being measured and will monitor CO2 and PM2.5.
EPC-16-006 Low Energy, Zero Liquid Discharge Adsorption Technology to Remove Contaminants and Recover Source Water	N/A	N/A	Yes; Calif Based Entity	This project could result in an innovative way to treat water with high amounts of metal contaminants using a low energy treatment method to restore impaired drinking water sources. The hydrogel adsorption process offers benefits of being simple, with its minimal amount of equipment required and can save water that would normally be too difficult to treat. This treatment method is especially suitable for small inland treatment systems, where liquid backwash and brine disposal may be cost prohibitive or infeasible.	1h, 4c, 4d	The recipient completed installation of the system at the City of Cerritos and has begun the measurement and verification phase. The project term was extended due to various issues hindering flow rate and initial contaminant levels.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-007 Optimization of Energy Efficiency to Achieve Zero-Net Energy in Multifamily and Commercial Buildings	Applied Research and Development	This is a modeling study. The recipient uses EnergyPlus, a building energy modeling tool, to analyze the cost-effectiveness of various electricity saving/generation measures for multifamily and commercial buildings in California. Each building type and climate zone will receive a cost-benefit analysis for each measure individually and an optimized package of measures to achieve as close to zero net energy as is cost-effectively possible.	7/13/2016	No	Demand-side Management	$1,000,000	$1,000,000	$274,714	N/A	$274,714
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-008 Santa Monica Advanced Energy District	Market Facilitation	The city of Santa Monica designed an advanced energy district with a multiuser microgrid that is anchored at the City Yards, an old landfill site where most of the city's municipal buildings and fleets are housed. The design integrates a suite of local renewable energy sources, energy storage, and controllable loads into a single system that can be scaled to interconnect adjacent, public and private properties inclusive of the Bergamont Art District and Metro Maintenance Facility. The project team explored what role the city can play in delivering and wheeling power between customers, and what special utility tariffs and financing can help incentivize a system that shares the value of distributed energy resources equitably. Next, the project team developed a financial and ownership model for constructing and operating a multiuser microgrid that achieves a net-zero, or near net-zero energy district for the customers. A case study and tool kit of outreach materials was developed to share with stakeholders and other local governments.	8/10/2016	No	Demand-side Management	$1,487,609	$1,487,609	$48,440	N/A	$48,440
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-009 Testing a Low-Energy Water Treatment System for Fail-Safe Direct Potable Reuse	Applied Research and Development	The project is testing a low-energy, dual barrier, direct potable reuse system, known as dprShield, with breach-activated barrier technology to demonstrate that this technology can improve public health safeguards and reduce the electrical energy, chemical consumption, maintenance and overall cost for potable reuse of municipal wastewater. While being energy efficient and cost-effective, this system effectively removes trace contaminants through two tight membranes. In the event that one of the membrane barriers is breached, a Breach Activated Barrier is triggered and the contaminants are pushed away from the clean water stream, ensuring safe operation in real time. This direct potable reuse technology could replace more energy intensive processes.	8/10/2016	No	Demand-side Management	$999,795	$999,795	$682,969	N/A	$682,969
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-010 Improving Water and Energy Efficiency in California's Dairy Industry	Applied Research and Development	This project tests and demonstrates two novel approaches to cooling livestock. With conduction cooling, the bedding area beneath the cow is cooled using heat exchange mats below the stall bedding. To reduce energy consumption, water flowing through the heat exchange mats is chilled using a novel Sub-Wet Bulb Evaporative Chiller. The second approach, targeted convection cooling, uses fabric ducting to direct cool air on the cows. The air is cooled using high-efficiency direct evaporative coolers. Both approaches promise significant water and energy savings, when compared to current approaches.	8/10/2016	No	Demand-side Management	$1,000,000	$1,000,000	$356,896	N/A	$356,896

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EPC-16-007 Optimization of Energy Efficiency to Achieve Zero-Net Energy in Multifamily and Commercial Buildings	$151,821	$0	Electric Power Research Institute, Inc.; Regents of the University of California, Davis;	$105,000	9.5%	Grant	Pre-existing intellectual property identified in agreement EPC-16-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Regents of the University of California, Davis	Group 4: Ranked # 1
EPC-16-008 Santa Monica Advanced Energy District	$570,347	$0	Arup North America Ltd; City of Santa Monica; Hathaway Dinwiddie Construction Company; Miller Hull Partnership; Buro Happold Engineering;	$253,030	14.5%	Grant	Pre-existing intellectual property identified in agreement EPC-16-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	City of Santa Monica	Group 2: Ranked # 2
EPC-16-009 Testing a Low-Energy Water Treatment System for Fail-Safe Direct Potable Reuse	$248,634	$0	Orange County Water District; Leland Stanford Junior University; Porifera, Inc.; City of Hayward;	$144,784	12.6%	Grant	Pre-existing intellectual property identified in agreement EPC-16-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Porifera, Inc.	Group 1: Ranked # 2
EPC-16-010 Improving Water and Energy Efficiency in California's Dairy Industry	$191,936	$0	Regents of the University of California (University of California, Davis);	$164,710	14.1%	Grant	Pre-existing intellectual property identified in agreement EPC-16-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Regents of the University of California (University of California, Davis)	Group 1: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-007 Optimization of Energy Efficiency to Achieve Zero-Net Energy in Multifamily and Commercial Buildings	N/A	N/A	Yes; Calif Based Entity	This project will accelerate the adoption of cost-effective electricity saving and generation technologies, equipment, materials and construction practices in California multifamily and commercial buildings. "]By developing new methods and expanding on existing modeling methods using Open Studio, a building energy modeling software developed by the Department of Energy, this project aims to enable rapid evaluation of energy efficiency packages to determine the most cost-effective approaches to achieve zero net energy buildings.	1f, 1h, 3e	The recipient continues to refine performance parameters for high efficiency measures. Work has begun on testing the Open Studio Parametric Analysis software to perform the large set of permutations required to provide a zero net energy optimization package. Work is ongoing to implement and test a method for automated optimized sizing of HVAC equipment in the toolset.
EPC-16-008 Santa Monica Advanced Energy District	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments must play a role in achieving the goal by operationalizing community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project pilots innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in December 2018. After evaluating several technical and financial options, the team developed three scenarios to provide a phased approach for a low-carbon energy solution to the City of Santa Monica and surrounding community. The base-case scenario includes 1.2 MW solar PV and 7.2 MWh energy storage to meet the projected energy demand for the redeveloped City Yards, and allows for 2 days of continued operation in a power outage. The two expansion scenarios include increased solar generation and energy storage, as well as fuel cells to meet the significantly higher demands for the adjacent Bergamont Art District, and the Metro's maintenance facilities located across the street. The City will vote on a final microgrid design once the City Yards redevelopment plan is complete and financing becomes available.
EPC-16-009 Testing a Low-Energy Water Treatment System for Fail-Safe Direct Potable Reuse	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	This project will demonstrate an energy efficient solution for direct potable reuse of municipal wastewater. The dprShield is estimated to use 65 percent less energy than State Water Project transfers, 75 percent less than desalination and more than 50 percent less energy than competing technologies for direct potable reuse of municipal wastewater, removal of contaminants from water and real-time membrane integrity monitoring.	1f, 1h, 4c, 4d	The dprShield system has been installed at the Hayward and Orange County sites. Data collection is expected to be completed by May of 2019.
EPC-16-010 Improving Water and Energy Efficiency in California's Dairy Industry	N/A	N/A	None	This project advances management strategies for reducing thermal stress in dairy cows while also reducing energy and water use. There are two methods of reducing thermal stress in cows: (i) lowering the cow's heat exposure and (ii) increasing the cows ability to get rid of excess body heat. Current practice includes use of evaporative cooling with water sprayed on the cows using feed-line soakers, and cooling is enhanced by convective heat transfer via large overhead fans. This project will test and demonstrate an innovative approach that seeks to optimize the cow's ability to remove excess body heat by utilizing more efficient cooling technologies, and introducing alternate strategies for when and where to cool the cows. By combining these two approaches this project has the potential to significantly change the way dairy cows are cooled.	1e, 1f, 1h, 4a, 4c	Work continues to determine the most effective and market ready approach and technology for large scale demonstration at a dairy. After audits of several farms in the Galt area, and discussion with agricultural specific HVAC technicians, an additional technology strategy for cow cooling was identified and is being evaluated. This new approach has the potential to cost less and provide equivalent or better energy and water savings than had been obtained through the other methods. After this new approach has been evaluated a decision will be made to determine which technology will be implemented at full scale in summer 2019.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-011 Novel Membrane Technology to Improve Energy Efficiency and Water Savings in Wastewater Treatment Operations	Applied Research and Development	This project is demonstrating the performance of an innovative "amphiphilic" membrane (i.e., a combination of hydrophilic and hydrophobic properties) that keeps organic and inorganic foulants away from the membrane surface by incorporating an anti-adhesive. The amphiphilic membrane retards long-term foulant deposition, which allows for higher water flow through the membranes, increased water yield, and improved energy efficiency. The project demonstrates the effectiveness of the technology in treating surface water, backwash water and synthetic reclaimed water. Data is collected to document savings and benefits in order to encourage commercialization. Implementation of this technology does not require capital investment. Instead, treatment facilities could replace existing hydrophilic membranes with the amphiphilic membranes during routine scheduled membrane replacements.	8/10/2016	No	Demand-side Management	$882,430	$882,430	$483,266	N/A	$483,266
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-012 Power and Water Saving Advanced Hybrid Air/Wet Cooling System	Applied Research and Development	This project uses high performance porous fins to enhance cooling through water vaporization and mass transfer. By retrofitting the heat exchanger with a water spray feature, this project has the potential to reduce energy and water use of HVAC and refrigeration systems in California.	8/10/2016	No	Demand-side Management	$999,994	$999,994	$805,732	N/A	$805,732
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-013 Integrating Smart Ceiling Fans and Communicating Thermostats to Provide Energy-Efficient Comfort	Applied Research and Development	This project develops an optimal system configuration for smart comfort controlled ceiling fans integrated with learning thermostats. This system is to be tested and evaluated for energy performance and occupant acceptance in low income multi-family residential and small commercial buildings in disadvantaged communities in California. This research and development advances the solution's technology readiness level and support market adoption acceleration. A design guide and energy code language are to be developed to facilitate widespread adoption.	8/10/2016	No	Demand-side Management	$1,888,683	$1,888,683	$755,316	N/A	$755,316
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-014 A New Solution to California's Energy and Water Challenges: Reducing the Cost of Desalination and Increasing Water Reuse	Applied Research and Development	This project is demonstrating how to reduce the energy used to remove salt from wastewater using the flow-through electrode capacitive desalination (FTE-CD) technology. This advanced technology removes salt from water by applying an electric field to two porous electrodes. The electrodes act like a magnet for salt while the field is applied and remove the salt from water that flows through the electrodes using less energy and less costly than reverse osmosis (RO). Energy use of an FTD-CD system is projected to be 50% less compared to the energy use for an RO system. The recipient is partnering with two water districts to test the use of FTE-CD devices to desalinate wastewater and determine how this small, flexible device can improve the energy and operating efficiency of wastewater treatment solutions for communities. Wastewater from the industrial and municipal sectors will be used to test the technology along with measuring energy use and performance, such as fouling and other operation issues.	8/10/2016	No	Demand-side Management	$999,040	$999,040	$750,000	N/A	$750,000

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EPC-16-011 Novel Membrane Technology to Improve Energy Efficiency and Water Savings in Wastewater Treatment Operations	$304,611	$0	Kennedy/Jenks Consultants; BASF; California Water Services;	$98,600	10.1%	Grant	Pre-existing intellectual property identified in agreement EPC-16-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Kennedy/Jenks Consultants	Group 1: Ranked # 3
EPC-16-012 Power and Water Saving Advanced Hybrid Air/Wet Cooling System	$529,685	$0	Altex Technologies Corporation;	$187,207	15.8%	Grant	Pre-existing intellectual property identified in agreement EPC-16-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Altex Technologies Corporation	Group 1: Ranked # 5
EPC-16-013 Integrating Smart Ceiling Fans and Communicating Thermostats to Provide Energy-Efficient Comfort	$188,176	$0	Center for the Built Environment - UC Berkeley; BIG ASS FANS;	$315,926	14.3%	Grant	Pre-existing intellectual property identified in agreement EPC-16-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	The Regents of the University of California on behalf of the Berkeley campus	Group 1: Ranked # 2
EPC-16-014 A New Solution to California's Energy and Water Challenges: Reducing the Cost of Desalination and Increasing Water Reuse	$448,176	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Lawrence Livermore National Laboratory	Group 1: Ranked # 6

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EPC-16-011 Novel Membrane Technology to Improve Energy Efficiency and Water Savings in Wastewater Treatment Operations	N/A	N/A	Yes; Calif Based Entity	A survey by the American Membrane Technologies Association (AMTA) indicates that there are approximately 100 microfiltration/ultrafiltration treatment plants with a total design capacity of approximately 400 MGD, eight nanofiltration facilities (30 MGD), and over 100 reverse osmosis (RO) facilities (400 MGD) in California. As membrane treatment is energy intensive due to fouling, this technology could reduce energy demand for membrane treatment processes while decreasing the water need for backwashing.	1f, 1h, 3a, 4a, 4c	The recipient has completed pilot demonstration using all the three waters (surface water, organic spiked water, backwash water) at the Cal Water site, Bakersfield. Pilot operating data on two ultrafiltration membranes (R&D membrane and standard membrane) has showed that, despite the R&D membrane outperforming the standard membrane during the initial testing period, performance decreased after a few cleaning cycles. The reason for the loss of performance may be because special chemical functional groups responsible for the R&D membranes fouling resistance and reduced pumping costs were lost during the membrane cleaning process. The draft final report is expected February 28, 2019.
EPC-16-012 Power and Water Saving Advanced Hybrid Air/Wet Cooling System	N/A	N/A	Yes; Calif Based Entity	The hybrid cooling system is estimated to reduce fan power through low pressure drop characteristics and save water by only using water evaporation when ambient air temperatures are high. The system aims to improve efficiency in commercial and industrial refrigeration and air conditioning systems.	1f, 1h, 4a, 4c	The hybrid heat exchanger system is operational and the team is adjusting parameters to optimize energy and water performance. During December 2018 a third party M&V team will validate site monitoring instrumentation and data collection procedures, as well as providing feedback on an updated test plan. After validation of site conditions and updating the test plan M&V will continue through Q3 of 2019.
EPC-16-013 Integrating Smart Ceiling Fans and Communicating Thermostats to Provide Energy-Efficient Comfort	N/A	N/A	Yes; Calif Based Entity	Smart ceiling fans integrated with smart thermostats represent the next generation of energy efficiency that provides space conditioning while minimizing the need for compressor based air conditioning systems. This project advances the state of knowledge and practical applications of an integrated strategy to retrofit applications, addressing occupant thermal comfort and HVAC energy use through innovative hardware and software. This project is a scalable energy retrofit solution for commercial and residential buildings. Installation does not require advanced specialized training, appropriately trained contractors or installers can easily perform the task. Operations are simple and do not need users to understand controls, set-points, or programming. Simple installation and controls with documented savings and no sacrifice on comfort could increase acceptance of this technology. [/	1f, 1h, 3a, 3e, 4a	The project is on track. The research team completed laboratory testing of the integrated thermostat and fan system. Data loggers, sensors and other monitoring devices were installed in July 2017 at all sites and 12 months baseline energy data was collected. Ceiling fans and thermostat installations were completed in August 2018 at all five sites. Data from all sites is being collected and analyzed. Data collection will occur for a period of 12 consecutive months.
EPC-16-014 A New Solution to California's Energy and Water Challenges: Reducing the Cost of Desalination and Increasing Water Reuse	N/A	N/A	Yes; Calif Based Entity	The FTE-CD technology has the potential of reducing the cost and energy use associated with desalinating water with low to moderate salt content and will represent an advancement over current RO technology. This can increase the potential to increase water recycling and reuse at the community or industrial level, which could reduce the need to procure and transport fresh water sources. Also, this advanced FTE-CD technology is small and flexible which means that it can be customized to the scale needed for each community or industry, thereby increasing a community's water reuse potential which can increase drought resilience for the state.	1f, 1h, 4d	The recipient has designed and modified end plates to facilitate parallelization of electrodes and tested a setup with five electrodes in parallel to compare performance to an individual cell. Salt removal and charge efficiency of the parallel setup was approximately the average of the individual cells, but the total resistance was higher than expected, leading to a 50% higher energy cost compared to single cells. This resistance can be decreased if the leads to the cells are soldered together rather than just twined. The recipient has produced multiple electrode pairs at 8 x 12 cm electrode size and anticipate that the full device will require about 20 of these electrodes.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-015 Los Angeles Regional Energy Innovation Cluster	Market Facilitation	This project establishes the Los Angeles Regional Energy Innovation Cluster to act as a regional hub of the clean energy ecosystem and to give promising clean energy entrepreneurs in Los Angeles, Orange, Santa Barbara, and Ventura counties direct access to the region's top technical, business, outreach, and commercialization support services. This project assesses and addresses the region's energy needs by making use of and expanding resources for entrepreneurs and startups, including facilities, coaching, business support, speaking and networking engagements, and information about funding opportunities, all through connections facilitated by the Los Angeles Cleantech Incubator.	8/10/2016	No	Demand-side Management	$4,999,247	$4,999,247	$599,249	N/A	$599,249
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-016 Commercializing a Disruptively Low Cost Solar Collector	Applied Research and Development	This project has developed a low cost Concentrated Solar Power (CSP) collector to advance the market readiness of this technology. Hyperlight's CSP collector is based on the linear Fresnel reflector (LFR) and is able to make cost reductions through breakthroughs in materials, design, manufacturing and installation. A major innovation of the system involves use of mirrors attached to UV stabilized and low-cost plastic tubes that are mounted on sealed water bed foundation. The project has developed: (1) a single 1,000 square foot module used for lifecycle testing and validation of upgraded design elements; (2) a one-half acre system for pilot testing and demonstration; and (3) a front end engineering design study to establish the feasibility and what is needed to scale the system up to ten acres, and co-locate with other renewable energy such as a geothermal facility. EPIC funds are being used as cost share funding to Hyperlight's $1.5 million grant from the US DOE.	10/19/2016	No	Generation	$750,000	$750,000	$581,326	N/A	$581,326
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-017 Maximizing Energy Efficiency and Reducing Bio-solids Waste from New Anaerobic Wastewater Treatment Technology	Technology Demonstration and Deployment	This project is demonstrating the elimination of aeration and its high energy demands as part of secondary water treatment at the Silicon Valley Clean Water wastewater treatment facility using a novel staged Anaerobic Fluidized Bed Membrane Bioreactor. This System is projected to generate 30 percent less bio-solids than conventional systems that require aeration. This project also seeks to demonstrate the potential for development of a new high quality local water supply through non-potable and advanced potable reuse treatment trains that eliminate process steps that normally precede the use of reverse osmosis.	10/19/2016	No	Demand-side Management	$1,999,962	$1,999,962	$288,685	N/A	$288,685
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-018 Biological Double-Efficiency Process as an Advanced Wastewater Treatment Method to Achieve Substantial Energy and Water Savings	Technology Demonstration and Deployment	This project is demonstrating an efficiency technology that targets one of the major energy using steps in wastewater treatment. The Biological Double Efficiency Process (BDP) combines state of the art, easy to maintain aeration technology, airlift circulation/dilution technology, and an integrated all-in-one bioreactor technology to replace the separate anoxic and aerobic tanks associated with secondary clarifiers. The BDP is based on simultaneous nitrification/denitrification principles.	11/9/2016	No	Demand-side Management	$1,565,400	$1,565,400	$786,669	N/A	$786,669

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EPC-16-015 Los Angeles Regional Energy Innovation Cluster	$541,645	$0	California State University, Long Beach Research Foundation; Southern California Edison; Community Environmental Council; California State University, Northridge; Economic Development Corporation of Los Angeles County; California State Polytechnic University Pomona; Los Angeles Cleantech Incubator; Los Angeles Cleantech Incubator; Los Angeles County Office of Sustainability; Cleantech Orange County; CSU Dominguez Hills; CSU Los Angeles; CSU Channel Islands; LA Business Technology Center; CSU Water Resources and Policy Initiatives;	$3,658,099	42.3%	Grant	Pre-existing intellectual property identified in agreement EPC-16-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	2 out of 2 bidders	Los Angeles Cleantech Incubator	Ranked # 1
EPC-16-016 Commercializing a Disruptively Low Cost Solar Collector	$177,896	$2,252,694	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Hyperlight Energy	N/A***
EPC-16-017 Maximizing Energy Efficiency and Reducing Bio-solids Waste from New Anaerobic Wastewater Treatment Technology	$327,386	$0	Leland Stanford Junior University; Santa Clara Valley Water District; Silicon Valley Clean Water; GE Water; LG Water Solutions;	$1,219,943	37.9%	Grant	Pre-existing intellectual property identified in agreement EPC-16-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	8 out of 8 bidders	Silicon Valley Clean Water	Ranked # 1
EPC-16-018 Biological Double-Efficiency Process as an Advanced Wastewater Treatment Method to Achieve Substantial Energy and Water Savings	$15,486	$0	BDP Technologies;	$330,904	17.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	8 out of 8 bidders	BDP Technologies	Ranked # 2

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EPC-16-015 Los Angeles Regional Energy Innovation Cluster	N/A	N/A	Yes; Calif Based Entity	This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. This project will also support technologies based on the regional energy market needs and engage a diverse group of clean energy stakeholders to provide the support, network, and resources needed for accelerated clean energy commercialization.	2a, 3e	In 2018, the LA Regional Energy Innovation Cluster accepted its third cohort of portfolio companies to receive services, for a total of twenty-six startups who have engaged with this program to date. The program will continue to provide important technical and business services such as speaking and networking opportunities, access to business development resources, awareness of funding opportunities, and connections to local energy stakeholders. The program also recently off-boarded startups from its first cohort. The program helped these startups meet critical milestones, including advancement in technology readiness, expanded customer base and partnerships, increased staff, and follow-on funding. As of June 2018, startups receiving services from this program have received $9,376,000 in private follow-on funding and $1,348,000 in public follow-on funding.
EPC-16-016 Commercializing a Disruptively Low Cost Solar Collector	N/A	N/A	Yes; Calif Based Entity	The project will lead to technological advancement and breakthroughs by advancing a low cost CSP collector to commercial availability. In addition to the value of demonstrating the collector through the physical installation, the front end design study and the availability of this low cost collector is intended to enable geothermal power plant owners to use this innovative system to boost the output of their plants and provide more renewable energy to the grid. The resulting increase in heat transfer fluid temperature from 200 to 300 C expands the market for this technology from food processing to biofuel process plants and petroleum refining.	2a, 4a	Extensive optical, mechanical and thermal models were built that showed feasibility of technical targets. A prototype reflector of 20 feet by 50 feet was tested to 10,000 cycles representing a 30-year lifetime, and results of the testing showed minimal degradation. The project site preparation work was completed and the pilot system is operating as designed.
EPC-16-017 Maximizing Energy Efficiency and Reducing Bio-solids Waste from New Anaerobic Wastewater Treatment Technology	N/A	N/A	None	This project has the potential to lower energy costs of wastewater treatment and water recycling. The advanced technology used in this project is the Staged Anaerobic Fluidized Bed Membrane Reactor (SAFBMR) which eliminates the aeration stage of wastewater treatment. The aeration stage is one of the most energy intensive steps in wastewater treatment. The SAFBMR also has the potential to reduce operation and maintenance costs because bio-solids waste, which typically requires off-site disposal, is reduced, and the effluent does not require the typical microfiltration pre-treatment step prior to the reverse osmosis systems.	1f, 1h, 4a, 4c, 4e	The Research Team has finalized and submitted the Benchmark Report characterizing the performance and costs of existing systems used to treat wastewater for water reclamation and reuse. The design of the SAF-MBR system has been completed and the construction of the SAF-MBR pilot facility at Silicon Valley Clean Water's waste water treatment plant in Redwood City has begun. Installation is expected to be completed in second quarter of 2019.
EPC-16-018 Biological Double-Efficiency Process as an Advanced Wastewater Treatment Method to Achieve Substantial Energy and Water Savings	N/A	N/A	Yes; Calif Based Entity	The innovative BDP technology has the potential to provide substantial energy savings to wastewater treatment plants, including reducing 50 percent of the aeration required for secondary treatment, thus decreasing electrical energy requirements and greatly improves oxygen transfer efficiency to 48-52 percent compared to 20-30 percent in conventional technologies.	1f, 1h	The drilling of the Basin was completed and the recipient is revising the electrical plan per owner specifications. Construction is expected to be completed by the end of 2018. The recipient is on budget and schedule and is working on securing the air and water permits.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-019 21st Century Solutions for 20th Century Wind Projects	Applied Research and Development	This project aims to develop inexpensive, standardized turbine upgrades that will allow aged turbines to behave more similarly to modern turbines by dispatching on/off when it is beneficial. The upgrade is a low-cost, robust, wireless communication and control system. The project includes installation of wireless communications and a field demonstration of the turbine upgrades and the forecasting algorithm at an operating wind plant in collaboration with CAISO and wind plant owners. A field test is at an operating wind farm in the Tehachapi region.	3/8/2017	No	Generation	$810,438	$810,438	$327,177	N/A	$327,177
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-020 Recovery of Lithium from Geothermal Brines	Applied Research and Development	This project demonstrates a cost-effective integrated process for the recovery of lithium from geothermal brines based on: (1) new high-capacity selective composite sorbents comprised of inorganic lithium-ion sieves and lithium-ion-imprinted polymers; and (2) a new sorbent regeneration process using eco-friendly carbon dioxide/carbonic acid that will lead to the direct formation of high-purity lithium carbonate (Li2CO3). Compared to traditional methods of Li recovery from brines, the proposed high-capacity selective sorbents and their regeneration process are expected to lower the cost of Li production by enabling online separation with higher recovery efficiency, using smaller volumes of sorbents and minimizing processing time. The project demonstrates a lab-scale integrated separation process for the production of high-purity Li2CO3 from geothermal brines.	12/14/2016	No	Generation	$873,387	$873,387	$532,502	N/A	$532,502
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-021 High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network	Applied Research and Development	This project advances the current state for imaging subsurface flow paths, barriers, and heterogeneity in operating geothermal reservoirs through an integrated approach that combines the recent development of low-cost, dense seismic networks together with established state-of-the-art micro-earthquake imaging algorithms and rock physics concepts. The technical advancement of this project is the integration of these components into a system that can be cost-effectively, reliably and routinely deployed in operating geothermal fields to image the movement of fluids in space and time with high-resolution and fast-turnaround time from data collection, to processing, to imaging, to rock physics interpretations.	12/14/2016	No	Generation	$1,672,639	$1,672,639	$810,000	N/A	$810,000
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-022 Comprehensive Physical-Chemical Modeling to Reduce Risks and Costs of Flexible Geothermal Energy Production	Applied Research and Development	This project seeks to address the specific challenges of base-load and flexible-mode geothermal production, including wellbore and reservoir integrity, scaling, and corrosion. An improved THMC model is being developed and applied to better understand these issues. Flexible mode production typically includes daily cycles in production rate that result in extraordinary stress on the wellbore and reservoir system. The modeling and assessment is being conducted to predict short- and long-term impacts of flexible-mode production on liquid-dominant geothermal reservoir systems representative in California and the site-specific vapor-dominated Geysers Geothermal Field with flexible production pilot test data.	12/14/2016	No	Grid Operations/Market Design	$999,032	$999,032	$450,000	N/A	$450,000

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EPC-16-019 21st Century Solutions for 20th Century Wind Projects	$322,793	$0	Department of Mechanical and Aerospace Engineering - UC Davis;	$124,916	13.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Regents of the University of California (University of California, Davis)	Group 3: Ranked # 1
EPC-16-020 Recovery of Lithium from Geothermal Brines	$453,318	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	SRI International	Group 2: Ranked # 2
EPC-16-021 High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network	$537,304	$0	Jarpe Data Solutions;	$50,000	2.9%	Grant	Pre-existing intellectual property identified in agreement EPC-16-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1
EPC-16-022 Comprehensive Physical-Chemical Modeling to Reduce Risks and Costs of Flexible Geothermal Energy Production	$480,995	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 3

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-019 21st Century Solutions for 20th Century Wind Projects	N/A	N/A	None	Through development of an innovative, real-time dispatch system for legacy turbines and implementation of a low-cost, robust form of remote communication and control, this agreement addresses the inability to efficiently and quickly on and off dispatch turbines when grid and market conditions demand. The project will deliver a low cost standardized communication and control system for aged turbines capable of remote on/off dispatch, and create a grid, market, and weather forecasting system to enable automated dispatching of turbines in response to oversupply and low/no wind conditions.	1c, 3a, 3f, 4a, 5c	The communication and control hardware was installed on nine turbines at Windstream in Tehachapi, CA. Seven turbines were equipped with fully functional control systems, while the remaining two had the turbine start/stop capability disabled. Additionally, the project team chose three of the nine turbines located with a hill blocking their line of sight to the central office to confirm that the system could communicate beyond line of sight by passing data through intermediate nodes in the mesh network. The project team has gained knowledge and experience in the field demonstration and had to overcome some unexpected hurdles with legacy technology, such as the need of upgrading the electric meter and power supply since modern micro components run in lower power, and some legacy technology has the older style of electric meter and/or power supply.
EPC-16-020 Recovery of Lithium from Geothermal Brines	N/A	N/A	Yes; Calif Based Entity	This project will lead to technological advancement by enabling co-production of power and high-value metals from geothermal resources. The co-production of metals will improve the economic viability of geothermal power production, therefore increasing the penetration of geothermal renewable energy.	2a, 3g	The project has finished testing sorbents using synthetic brines to characterize specific surface area, selectivity, capacity, and adsorption kinetics. They have also completed sorbent regeneration testing to determine the regeneration kinetics, sorbent stability, and the purity of the lithium carbonate product. The project is integrating adsorption, regeneration, and product crystallization into a single process and expects to complete testing with actual geothermal brine by early 2019.
EPC-16-021 High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network	N/A	N/A	Yes; Calif Based Entity	This project will provide tools to help geothermal operations to be more productive. This project will demonstrate the advantages of a micro-earthquake imaging system that uses a dense network of seismic stations and automated processing to perform fast-turnaround, high-resolution imaging of fluid movement in producing geothermal reservoirs.	1c, 2a, 3a, 3b	Installation of the micro-earthquake stations at the demonstration site is complete and data has been retrieved. P-wave and S-wave velocity tomograms show improved resolution. The first visualizations of tomograms in terms of Vp, Vs, and elastic moduli were performed. The project will continue to refine, optimize, and benchmark the MEQ processing and imaging code base.
EPC-16-022 Comprehensive Physical-Chemical Modeling to Reduce Risks and Costs of Flexible Geothermal Energy Production	N/A	N/A	Yes; Calif Based Entity	This project will lead to technological advancement by providing modeling tools that can be used by geothermal operators to better understand the impacts of flexible-mode production on the reservoir-wellbore system. Such knowledge allows the development of power plant and control technologies to enable geothermal power plants to operate in different variable modes, and to be both a base-load and flexible renewable resource.	2a, 3a, 5a, 5f	The modeling tools have been completed. The project is continuing to model simulations for base-load and flexible production, and for liquid and steam dominant geothermal systems. The project has begun modeling real field cases.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-024 San Gabriel Valley Water Company "Plug and Play" In-Conduit Hydropower Development Project (SGVWC Project)	Applied Research and Development	The San Gabriel "Plug and Play"; In-Conduit Hydropower Development Project aims to design, develop and demonstrate a modular, cost-effective in-conduit hydroelectric system designed for the sub-100-kW in-conduit hydroelectric market that will decrease the civil, mechanical, electrical and interconnection costs. San Gabriel Project includes a new 73 kW modular "plug and play" in-conduit hydroelectric station at a space-constrained site in an urban, potable water system, that will provide an estimated 381,000 kilowatt-hours (kWh) of renewable generation, while also providing a model that can be deployed to many undeveloped, small sub-100 kW in-conduit sites throughout the state.	1/25/2017	No	Generation	$500,000	$500,000	$255,064	N/A	$255,064
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-025 Comprehensive Assessment, Tools and Resources for Advancing In-Conduit Hydropower in California	Applied Research and Development	This project aims to conduct a comprehensive assessment of in-conduit hydropower generation potential in California and develop a guidebook and a business case assessment tool that assist municipal, agricultural, and industrial water purveyors with the cost effective implementation of in-conduit hydropower generation projects. The proposed guidebook and the business case assessment tool will provide invaluable knowledge base for municipal (water and wastewater), agricultural and industrial agencies that are considering capturing hydrokinetic/hydrostatic energy and integrating in-conduit hydropower into the existing energy mix. The Business Case Assessment Tool will assist users with building a business case for implementation of an in-conduit hydropower project, providing qualitative and quantitative guidance on the selection of equipment and sites for fit-for-purpose applications.	1/25/2017	No	Generation	$400,000	$400,000	$297,103	N/A	$297,103
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-026 Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants	Applied Research and Development	This agreement develops and pilots tests integrated control strategies for demand response (DR) at two demonstration sites in California: a water pumping station and an industrial refrigerated warehouse. Both test sites have built-in energy storage capabilities. The pumping station stores energy in water pumped uphill, while the refrigerated warehouse stores energy as thermal mass in frozen food. The capacity for storage allows for temporary shed, shift or adjustment in power demand. The proposed technology will integrate controls, energy cost, historic load data, and tariff information to allow for optimized demand response. These control strategies are expected to be practical and technically feasible.	5/10/2017	No	Demand-side Management	$3,000,000	$3,000,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-027 Facilitating On-farm Participation in Energy Demand Management Programs	Applied Research and Development	This project develops a management tool for optimizing irrigation at 10 farms in California. The sites have varied water requirements, growing a mix of almonds and alfalfa. The project is validating a pre-commercial water management system that allows irrigators to have more flexibility over when they irrigate and use energy. Instead of adding water whenever the soil is dry, this system will manage plant stress so that water can be delivered when costs are low and when needed by the plant. The purpose of the management technology is to enable irrigators to participate in utility incentive programs offering benefits to customers who can shift their energy demand. This management approach would enable participation in utility demand response, time of use, and automated demand response programs.	3/8/2017	No	Demand-side Management	$1,588,872	$1,588,872	$381,486	N/A	$381,486

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-024 San Gabriel Valley Water Company "Plug and Play" In-Conduit Hydropower Development Project (SGVWC Project)	$13,082	$0	NLine Energy, Inc.; San Gabriel Valley Water Company;	$782,000	61.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	San Gabriel Valley Water Company	Group 1: Ranked # 1
EPC-16-025 Comprehensive Assessment, Tools and Resources for Advancing In-Conduit Hydropower in California	$121,338	$0	Leland Stanford Junior University; NLine Energy, Inc.; Stantec Consulting Services Inc. ;	$83,018	17.2%	Grant	Pre-existing intellectual property identified in agreement EPC-16-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Stantec Consulting Services Inc.	Group 1: Ranked # 4
EPC-16-026 Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants	$884,720	$0	Electric Power Research Institute, Inc.; San Diego Gas and Electric Company; Southern California Edison;	$465,000	13.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Electric Power Research Institute, Inc.	Phase 1 Group 2: Ranked # 5
EPC-16-027 Facilitating On-farm Participation in Energy Demand Management Programs	$166,426	$0	Irrigation for the Future, Inc.;	$126,663	7.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Irrigation for the Future, Inc.	Phase 1 Group 2: Ranked # 4

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-024 San Gabriel Valley Water Company "Plug and Play" In-Conduit Hydropower Development Project (SGVWC Project)	N/A	N/A	Yes; Calif Based Entity	The project will recover wasted energy from an existing pressure reducing station, thereby addressing a key component of the Water-Energy nexus, an on-going proceeding at the CPUC and Energy Commission. The recipient estimates there to be about 120 similar-sized pressure reducing opportunities within California representing 9,000 kilowatts that will become economically viable if the project is able to meet its cost reduction goals.	1a, 1b, 2a	The overall design of the project has been delayed due to the initial late start of the project as well as the need for completion of the water balancing study. With a turbine lead time of 6 months, a decision was made to push the project construction to fall 2018 to ensure that San Gabriel Valley Water Company can meet peak demands in the summer time. The project is expected to be commissioned in the first quarter of 2019.
EPC-16-025 Comprehensive Assessment, Tools and Resources for Advancing In-Conduit Hydropower in California	N/A	N/A	Yes; Calif Based Entity	Newer in-conduit hydroelectric turbine technology research and development has not been adequately covered in any published guidebook. The available guidebooks do not include many of these novel technologies nor do they include performance information, associated equipment, siting criteria, civil, mechanical and electrical design considerations, costs or other relevant information that will assist California's stakeholders in determining which in-conduit hydroelectric technologies are best suited for a particular site.	1a, 3a, 3b	The team estimates the in-conduit hydropower potential in California by analyzing the on-site survey data collected by NLine Energy, the results from a questionnaire presented by the team and distributed to various water agencies, as well as crossing data from USGS, DWR and SWRCB database. The estimate concluded that while there is at-least 343 MW of installed in-conduit hydropower facilities in California as of 2017, there is potential for further installations up to 414 MW across 450 different locations. The team also conducted eight case studies, which identified that small in-conduit hydropower projects should consider multiple scenarios at the feasibility stage to investigate different hydrologic conditions, and interconnection costs can vary considerably.
EPC-16-026 Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants	N/A	N/A	Yes; Calif Based Entity	This project develops technology that will enable industrial customers to provide automated DR service to the grid including fast ramping, operating reserves, frequency regulation, and peak load reduction in support of California's goals for DR and energy efficiency as well as renewable integration and greenhouse gas emissions reduction.	1g	The project is on schedule. 1.The water pumping station team is evaluating the water system components, operating speeds of variable speed pumps in relationship of speed to power consumption, and flow rates. In October, 2018, the team met with California Water Service staff to obtain feedback on the feasibility of day-ahead DR targets, additional data to be collected and requested tank level data. 2.The refrigeration site team continues to analyze the utility meter data to understand impacts of current controls on the load profile. The team is planning tests with DR signal to the refrigeration units at the site. They are preparing deliverables: technology/knowledge transfer plan, the site installation and interface summary data, and operator interview findings.
EPC-16-027 Facilitating On-farm Participation in Energy Demand Management Programs	N/A	N/A	None	The agreement tests an irrigation management system that facilitates use of partial irrigation strategies, enabling flexible energy load control. This will allow irrigators to participate in utility demand response and time of use programs while providing flexibility to the grid.	1b, 1e, 1f, 1g, 2a, 4c	The research team continues to collect in-season measurement and observations at the cooperating farms in preparation for a full-scale field trial of the automated irrigation management system, Irrigation Management Online (IMO). This trial will employ the automated data integration and generate updated irrigation schedules which will be sent to the grower on-demand via the updated IMO interface. The IMO system will inform the growers of the water use and yield reduction consequences of participating in any particular DR or ADR event. The full-scale trial is expected to be implemented in 2019 and 2020 irrigation seasons.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-028 Irvine Ranch Water District Load Shifting and Demand Response Pilot Project	Applied Research and Development	This project develops, tests, and validates a load-shifting optimization platform to reduce energy use and demand charges in the water sector. The platform advances pre-commercial demand response technologies to reduce: peak demand, energy use, and operational costs. The platform integrates advanced real-time monitoring, automated load shifting control, energy storage, and a pre-commercial cost optimization platform. Data generated by the project will validate the approach and identify best practices for increasing water sector participation in demand response programs.	3/8/2017	No	Demand-side Management	$1,403,465	$1,403,465	$88,515	N/A	$88,515
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-029 Water/Energy Bank Proof-of-Concept	Applied Research and Development	This proof of concept study is evaluating the feasibility of using groundwater storage and cycling surface reservoirs to shift the State Water Project's Southern California water deliveries to non-summer months to reduce summer electric grid peak demand. Shifting the timing of water deliveries could reduce solar and wind power over-generation risk during non-summer months when renewable energy is in surplus. This project investigates the technical, institutional, legal and economic feasibility of implementing a guaranteed water delivery shift and develop demand response and load shifting tools and strategies to manage peak load and demand and thereby reduce energy costs in the water sector.	3/8/2017	No	Demand-side Management	$1,000,000	$1,000,000	$637,571	N/A	$637,571
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-030 Enabling Energy Efficient Data Centers in Smart Power Distribution Systems	Applied Research and Development	This project is researching and testing technologies that improve data center energy efficiency at three different levels in a smart power distribution system. The technologies include increasing server energy efficiency, through coordinated deep sleep and dynamic voltage-frequency scaling (DVFS); data center workload balancing through phase and load balancing across multiple servers in a data center; and geographical workload balancing through phase/load balancing in a single or multiple power distribution network or feeder.	3/8/2017	No	Demand-side Management	$1,783,118	$1,783,118	$178,943	N/A	$178,943
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-031 VOLTTRON Testing Tool Kit	Applied Research and Development	This federal cost share project demonstrates the benefits of the VOLTTRON platform for DER management through the testing of the VOLTTRON Testing Tool Kit. VOLTTRON is a US Department of Energy funded open source platform intended to provide a software base for integrating management of energy demand in buildings, distributed energy resources, and the electrical grid. The tool kit includes simulation test suites, a platform monitoring and debugging tool, and more extensive database support to promote wider adoption of VOLTTRON platform beyond its original set of developers. By lowering implementation costs and adding easy adoption features, the tool kit encourages adoption by other users, including organizations and private entities seeking to develop DER integration projects.	3/8/2017	No	Demand-side Management	$70,000	$70,000	$70,000	N/A	$70,000

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EPC-16-028 Irvine Ranch Water District Load Shifting and Demand Response Pilot Project	$832,615	$0	Advanced Microgrid Solutions, Inc.; Pam Seidenman Consulting;	$760,393	35.1%	Grant	Pre-existing intellectual property identified in agreement EPC-16-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Advanced Microgrid Solutions, Inc.	Phase 1 Group 2: Ranked # 3
EPC-16-029 Water/Energy Bank Proof-of-Concept	$150,000	$0	Antelope Valley Water Storage, LLC;	$225,000	18.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Antelope Valley Water Storage, LLC	Phase 1 Group 2: Ranked # 1
EPC-16-030 Enabling Energy Efficient Data Centers in Smart Power Distribution Systems	$306,631	$0	San Jose State Research Foundation; The Regents of the University of California (UC Riverside);	$297,064	14.3%	Grant	Pre-existing intellectual property identified in agreement EPC-16-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Regents of the University of California, Riverside Campus	Phase 1 Group 1: Ranked # 3
EPC-16-031 VOLTTRON Testing Tool Kit	$28,501	$805,000	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	SLAC National Accelerator Laboratory	N/A***

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EPC-16-028 Irvine Ranch Water District Load Shifting and Demand Response Pilot Project	N/A	N/A	Yes; Calif Based Entity, Woman Own	The project integrates several pre-commercial and commercial technologies into a platform that enables operational equipment and energy storage resources to respond automatically to energy price signals. The integrated approach promotes greater participation in demand reduction events, including the ability to participate without prior-day notice.	1e, 1f, 1g, 1h, 4a	The project team has conducted energy audits of the pilot sites, modeled facility load profiles, and assessed which tariffs are most advantageous for reducing peak demand and energy. The largest pilot sites are on new tariffs that allow participation in the local capacity resource program. The team has begun design, engineering and installation of battery storage systems. They are analyzing site operation requirements, control diagrams and strategies, and evaluating control equipment for automated load control.
EPC-16-029 Water/Energy Bank Proof-of-Concept	N/A	N/A	Yes; Calif Based Entity	The project could lower peak demand on the electric grid during Summer months when power demand is at its highest levels. This will increase the reliability of the electric grid system, reduce the use of peaker plants that operate on fossil fuels to meet system demand and operating margins, and lower Department of Water Resource's water transport costs by shifting electric demand to non-summer months when demand and energy rates are lower.	1e, 1f, 4a, 5b	The technical report is complete and includes all the complex analysis for this project. Using the Edmonston pumping plant for the analysis, implementation of the recipient's recommendations would lead to an average peak load reduction of 60 MW from July to September based on a normal water year. A notable finding is the possibility of converting the Water-Energy Bank into an energy neutral operation through the use of 40 MW of solar arrays and 5 MW of hydropower. The draft final report will include information from the technical report and will be submitted in January 2019. The recipient presented the Water-Energy Bank concept at the Demand Response and Distributed Energy Resources World Forum on October 16, 2018 and plans to publish results in journals and disseminate results at conferences such as the American Water Works Association CA-NV spring conference.
EPC-16-030 Enabling Energy Efficient Data Centers in Smart Power Distribution Systems	N/A	N/A	Yes; Calif Based Entity	Data centers are a major consumer of electricity. In the PG&E service territory, peak demand of data centers is around 500 MW, representing 2.5% of peak load consumption. The energy use from data centers is expected to increase by 4% annually in the next 5-10 years. The development of agile energy efficiency solutions for data centers is needed. This project provides unique software based solutions, rather than hardware solutions, to reduce electricity consumption by data centers through deep sleep and dynamic voltage frequency scaling, peak efficiency scheduling and spatial workload scheduling. If successful, potential electricity savings of up to 35% could result.	1f, 1g, 2a	The project team has completed the modeling of the Peak Efficiency Scheduling Algorithm and have preliminary average results of approximately 15% overall energy usage reduction. The project team is now working on development of the load migration and the demand response algorithms.
EPC-16-031 VOLTTRON Testing Tool Kit	N/A	N/A	Yes; Calif Based Entity	Communication of DERs with grid operators is critical for successful utilization of distributed energy resources. DOE developed the VOLTTRON platform to facilitate such communication. However, the platform is in its early stages and requires additional support and an expanded user base to become widely adopted. The VOLTTRON Testing Tool Kit provides new tools to confidently run a high qualify open source project. All knowledge gained and software written will be pushed to GitHub for open source use. With the testing tool kit, VOLTTRON becomes a more effective platform for DER management. This will enable higher utilization of DERs in support of the state's renewable energy and GHG reduction goals.	1d, 1e, 1f, 1g, 1h, 4a, 5b	A VOLTTRON hackathon (final project milestone) was held at SLAC on September 17, 2018. Participants received an initial orientation in VOLTTRON concepts and agent capabilities, and then were challenged to construct a system of VOLTTRON-linked DERs capable of demand response behavior. All tools developed for the Hackathon contributed back to the VOLTTRON open source repository on GitHub. The recipient is developing the final report for this agreement.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-032 Leading in Los Angeles: Demonstrating Scalable Emerging Energy Efficient Technologies for Integrated Facade, Lighting and Plug Loads	Technology Demonstration and Deployment	The project team is demonstrating and validating new retrofit package solutions from laboratory pre-testing through field demonstrations in existing government-owned commercial buildings. The solution sets, dubbed "INTER", are comprised of shading products from Rollease Acmeda and lighting and plug load systems and integrated controls, including HVAC systems, from Enlighted. The technologies can be combined and customized to suit a variety of building types and spaces, resulting in an estimated whole building energy reduction of 20 to 32 percent. Beginning in the Los Angeles basin, the team is leveraging existing market connections to increase and accelerate market adoption of these retrofit solution sets to maximize the potential energy and carbon savings, first in the region and ultimately, throughout California.	3/8/2017	No	Demand-side Management	$4,981,000	$4,981,000	$1,254,932	N/A	$1,254,932
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-033 Internet of Things and Ubiquitous Sensing in University Building Energy Management: Design Optimization and Technology Demonstration	Technology Demonstration and Deployment	This project develops and evaluates a pre-commercial energy management system at a building on the CSU Long Beach campus. The research uses energy efficient technologies with internet of things (IoT) controls in order to optimize load operation, load leveling, and peak shaving. The advancements in monitoring and controls from this project will enable deployment of similar systems at other academic facilities in California.	3/8/2017	No	Demand-side Management	$2,509,946	$2,509,946	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-034 Automated Cloud-Based Continuously Optimizing Building Energy Management System	Technology Demonstration and Deployment	This project is developing a software platform that helps building energy management systems run more effectively. The Automated Cloud-based Continuously Optimizing Building Energy Management System (ACCO-BEMS) automates and optimizes control of building systems and devices. It is being implemented at Pomona College in 11 buildings on campus, half of which will have ACCO-BEMS as a new building energy management system, the other half will have ACCO-BEMS integrated with the existing system.	3/8/2017	No	Demand-side Management	$2,500,000	$2,500,000	$1,408,017	N/A	$1,408,017
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-035 High-Performance Cu-Plating for Heterojunction Silicon Cells, Based on Ultra-Low-Cost Printed Circuit Board (PCB) Technology (Stage II)	Applied Research and Development	This project develops a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing, reducing costs by up to 35%, and increasing cell efficiency by 15%.	4/12/2017	No	Generation	$2,430,000	$2,430,000	$1,711,084	N/A	$1,711,084
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-036 Thermoelectric Generator Application and Pilot Test in a Geothermal Field	Applied Research and Development	Thermoelectric Generator (TEG) technologies have the potential to produce geothermal electricity without as much infrastructure (turbines, steam piping, etc.) thus making small scale production and geothermal powered micro power grids both practicable and affordable. Small (<5 MW) geothermal projects could provide consumers with the same distributed power flexibility provided by solar and wind production with the additional benefit of being a more reliable baseload source of electricity. TEG technologies can also allow geothermal heat to provide balancing and grid support. This project is scaling up a TEG from the watt-level in the lab to a 20 kW unit for demonstration in a geothermal reservoir.	4/12/2017	No	Generation	$1,280,000	$1,280,000	$143,349	N/A	$143,349

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-032 Leading in Los Angeles: Demonstrating Scalable Emerging Energy Efficient Technologies for Integrated Facade, Lighting and Plug Loads	$1,767,847	$0	Southern California Edison; United States Department of Energy; TRC Engineers, Inc.; Enlighted Inc.; Rollease Acmeda, Inc.; Delos;	$1,725,500	25.7%	Grant	Pre-existing intellectual property identified in agreement EPC-16-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 8 out of 10 bidders	New Buildings Institute, Inc.	Phase 1 Group 1: Ranked # 1
EPC-16-033 Internet of Things and Ubiquitous Sensing in University Building Energy Management: Design Optimization and Technology Demonstration	$402,014	$0	Regents of the University of California, Riverside Campus; CSU Long Beach Research Foundation; Enlighted Inc.; ControlWorks, Inc.;	$1,072,958	29.9%	Grant	Pre-existing intellectual property identified in agreement EPC-16-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 8 out of 10 bidders	CSU Long Beach Research Foundation	Phase 1 Group 2: Ranked # 2
EPC-16-034 Automated Cloud-Based Continuously Optimizing Building Energy Management System	$552,488	$0	Zero Net Energy (ZNE) Alliance; MelRok, LLC;	$1,184,891	32.2%	Grant	Pre-existing intellectual property identified in agreement EPC-16-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 8 out of 10 bidders	Zero Net Energy (ZNE) Alliance	Phase 1 Group 2: Ranked # 1
EPC-16-035 High-Performance Cu-Plating for Heterojunction Silicon Cells, Based on Ultra-Low-Cost Printed Circuit Board (PCB) Technology (Stage II)	$730,620	$9,540,309	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Sunpreme, Inc.	N/A***
EPC-16-036 Thermoelectric Generator Application and Pilot Test in a Geothermal Field	$420,699	$0	Leland Stanford Junior University; AltaRock Energy, Inc.;	$118,095	8.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	AltaRock Energy, Inc.	Group 1: Ranked # 3

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-032 Leading in Los Angeles: Demonstrating Scalable Emerging Energy Efficient Technologies for Integrated Facade, Lighting and Plug Loads	N/A	N/A	Yes; Calif Based Entity	This project creates a holistic, low-barrier integrated retrofit solution for significant energy savings. The scalable energy retrofit solution will be demonstrated in municipal government buildings but is also applicable to other commercial and residential buildings and to new construction and existing buildings. Installation does not require specialized training. The integration of technologies can produce higher savings than individual technologies operated in isolation. This solution will support California's statewide zero net energy and existing building goals.	1f, 1h	The project is on schedule. Testing the INTER system at LBNL's FLEXLAB started in October 2018. Accomplishments to date include meeting with manufacturers (Rollease and Enlighted) to obtain technical specifications and identify potential product tests and modifications, establishing FLEXLAB bench test methodology and priorities, creating selection criteria for demonstration sites including applicability of the technology packages, access to monitoring and verification and occupant feedback, and transferability of benefits to the larger California marketplace. As a result, ground work for the retrofit of several buildings at CSU Dominguez Hills and the City of Santa Ana started in August 2018. The first Technical Advisory Committee meeting was held in November 2018, and technology transfer plan has been submitted to the Energy Commission for review.
EPC-16-033 Internet of Things and Ubiquitous Sensing in University Building Energy Management: Design Optimization and Technology Demonstration	N/A	N/A	None	The project aims to remove barriers to achieve widespread deployment of state-of-the-art energy management technologies. The project provides California IOUs, academic institutions (universities, including 22 CSU campuses), energy management technology developers, and other stakeholders with an IOT-based energy management platform. Additionally, the project provides a comprehensive example of the potential for large scale deployment, including technical considerations, building performance, energy savings, and non-energy benefits.	1f, 1g, 1h	The IoT LED lighting system and plug-in load controllers were installed on all four floors of the Engineering and Computer Sciences building at CSU Long Beach. The HVAC controls will be installed during the 2018-19 winter break. After installation is complete, the team will evaluate which loads and devices can participate in anytime load reductions during demand response events.
EPC-16-034 Automated Cloud-Based Continuously Optimizing Building Energy Management System	N/A	N/A	Yes; Calif Based Entity	Energy performance monitoring and fault detection diagnostics software is a key technology that must be further enhanced and deployed to overcome barriers to achieving ZNE buildings. A principal barrier to real-time management of energy systems is the many, often incompatible, protocols and interfaces used by energy devices and sensors. These have long represented a barrier to the integration of discrete systems, sensors and actuators necessary to automatically assess and control energy use. This project uses an internet-of-things gateway to communicate with the various energy using devices in the building using their native protocol and interface. The platform uses machine learning to assess real-time building performance and automatically adjust individual devices. The technology eliminates building drift and negates the need for expensive reprogramming or optimization measures.	1f, 1h, 4a	The ACCO BEMS system is now installed at 10 of the buildings on the Pomona College campus. Next steps include commissioning the system, running fault detection, and further optimizing the building energy management system. Additional sensors and actuators have been installed and the project team has developed scripts to retrieve data from multiple sensors and BEMS points.
EPC-16-035 High-Performance Cu-Plating for Heterojunction Silicon Cells, Based on Ultra-Low-Cost Printed Circuit Board (PCB) Technology (Stage II)	N/A	N/A	Yes; Calif Based Entity	The project is developing a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing. This new process will lower electricity-related greenhouse gas (GHG) emissions and improve solar cells' efficiency.	1b, 1c, 2a, 3b, 4a	The project is well underway and the research team has established a manufacturing lane for copper patterning on silicon photovoltaic cells. Critical manufacturing tools (e.g., exposure, developer, stripper, etcher, and laminator) have been ordered and installed; commercial laminator tool has been modified; and dual-sided exposure tool for high-throughput wafer patterning has been developed. In the first quarter of 2018, the team fabricated cells with 24.03% efficiency and performed in-house reliability testing. Fifteen of these copper-metallized modules will be submitted for 3rd party testing. in June 2018, interim project results were presented at the World Conference on Photovoltaic Energy Conversion (WCPEC-7). In the next few months, the team will move to new lab facilities and continue process optimization and cell testing with the purpose to increase manufacturing throughput.
EPC-16-036 Thermoelectric Generator Application and Pilot Test in a Geothermal Field	N/A	N/A	None	This project will develop a means to expand use of low temperature and stranded geothermal resources by making small scale production both practicable and affordable.	1a, 1b, 1c, 2a, 3b	The test unit was completed and was tested in the lab. A series of modifications to the test unit to improve performance have been implemented and tested. An improved lab-scale unit with five layers of TEG modules is being built. The project is about 3-6 months behind schedule. They have taken longer than expected testing and redesigning the lab scale unit. In the next few months, the project should finish work on the lab scale unit (task 2) and start designing the 20 kW field scale unit (task 3).

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-037 The Amador Water Agency In-Conduit Hydropower Development Project (AWA Project)	Applied Research and Development	The goal of this project is to design, test, and demonstrate a 417 kW in-conduit Pelton turbine runner at an existing Pressure Reducing Station (PSR) site located in Ione, California. The project will demonstrate the ability to maximize the wasted energy captured at the station using an improved design of a higher-efficiency Pelton turbine runner specifically designed for small, in-conduit hydroelectric applications to contribute in the integration of in-conduit small hydropower into the existing state energy mix.	4/12/2017	No	Generation	$750,000	$750,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-038 Use of Indoor Rearing for Head-Starting Desert Tortoises	Applied Research and Development	The project conducts experimental releases of juvenile desert tortoises raised since 2011-2013 to evaluate the trade-offs of head-start duration on post-release survival of desert tortoises. The recipient is dividing hatchlings into two cohorts, raising half of them exclusively outdoors and the other half under a combination of indoor/outdoor rearing, releasing them as 2 year olds, and comparing their post-release survival. Data on the growth and survival of animals in this study provides guidance on the minimum duration of outdoor head-starting and whether indoor head-starting should be pursued in future head-starting programs for desert tortoises. Ultimately, the results of the study can inform the extent to which head-starting both indoors and outdoors is a viable solution for mitigating localized impacts to tortoise populations affected by development for solar energy production facilities.	4/12/2017	No	Generation	$493,089	$493,089	$128,079	N/A	$128,079
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-039 A Life Cycle Assessment of the Environmental and Human Health Impacts of Emerging Energy Storage Technology Deployment	Applied Research and Development	This project investigates whether flow batteries are a viable option for providing grid energy storage at the large scale, either in place of or alongside lithium-ion battery technology. The researchers are examining a life cycle-based characterization of the environmental impacts and resource usage associated with three chemistries of flow batteries (Vanadium Redox (V2O5), Zinc-Bromide (ZnBr), and Iron-Sodium (FeNa)). Specifically, they are investigating materials use, energy use, and toxic waste outputs of the life cycle phases of each flow battery type, including materials extraction, manufacturing, use, and disposal or recycling as applicable.	4/12/2017	No	Distribution	$600,000	$600,000	$155,924	N/A	$155,924
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-040 Assessing Cooling Tower PM2.5 and PM10 Emissions using Advanced Instrumentation, Plume Transects, and Plume Modeling	Applied Research and Development	This project measures PM2.5 and PM10 across the spray drift plume from two power plant cooling towers that use fresh water and brackish water. These measurements are used to develop and validate a model of power plant PM2.5 and PM10 emissions. The end result is a model that power plant operators can use to minimize the PM2.5 and PM10 effects of brackish water use in cooling towers.	4/12/2017	No	Generation	$700,000	$700,000	$47,077	N/A	$47,077
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-041 Benefits and Challenges in Deployment of Low GWP A3 Refrigerants in Residential and Commercial Cooling Equipment	Applied Research and Development	This project will develop test procedures and conduct testing for alternative refrigerants to assess flammability and to characterize energy savings. The recipient will also develop a favorability index of end-use market segments and equipment types based on potential GHG savings and commercial adoption feasibility.	4/12/2017	No	Demand-side Management	$500,000	$500,000	$155,800	N/A	$155,800

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-037 The Amador Water Agency In-Conduit Hydropower Development Project (AWA Project)	$0	$0	NLine Energy, Inc.; Amador Water Agency;	$1,115,000	59.8%	Grant	Pre-existing intellectual property identified in agreement EPC-16-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Amador Water Agency	Group 1: Ranked # 2
EPC-16-038 Use of Indoor Rearing for Head-Starting Desert Tortoises	$77,924	$0	The Regents of the University of California, Davis Campus;	$61,119	11.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Regents of the University of California (University of California, Davis)	Group 2: Ranked # 2
EPC-16-039 A Life Cycle Assessment of the Environmental and Human Health Impacts of Emerging Energy Storage Technology Deployment	$98,142	$0	The Regents of the University of California, Irvine;	$186,219	23.7%	Grant	Pre-existing intellectual property identified in agreement EPC-16-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	The Regents of the University of California, Irvine	Group 5: Ranked # 1
EPC-16-040 Assessing Cooling Tower PM2.5 and PM10 Emissions using Advanced Instrumentation, Plume Transects, and Plume Modeling	$108,004	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	The Regents of the University of California, Davis Campus	Group 4: Ranked # 1
EPC-16-041 Benefits and Challenges in Deployment of Low GWP A3 Refrigerants in Residential and Commercial Cooling Equipment	$221,625	$0	Institute for Governance and Sustainable Development;	$500,000	50.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Lawrence Berkeley National Laboratory	Group 7: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-037 The Amador Water Agency In-Conduit Hydropower Development Project (AWA Project)	N/A	N/A	None	The system developed under this project will recover and maximize the capture of wasted energy in Pressure Reducing Station (PRS) commonly used by the water agencies and industry; improve the efficiency, performance and cost of the Pelton turbine technology to capture wasted energy and provide a viable retrofit solution for degrading sites; and expand small hydropower deployment.	1a, 1b, 1c, 3a, 3b, 4a	The project kick-off meeting was held on July 14, 2017. The project has completed the design phase and has contracted with Gilkes to manufacture the turbine. Lead time for turbine is 36 weeks, with delivery expected in spring of 2019. AWA also procured a general contractor, Central Sierra Electric, to construct the project. All permits for the project have been secured and construction is underway. Project is projected to go on-line in September, 2019.
EPC-16-038 Use of Indoor Rearing for Head-Starting Desert Tortoises	N/A	N/A	None	The research will be the first to evaluate the trade-offs in duration of head-starting on post-release survival in the eastern Mojave Desert where numerous solar production facilities have been recently constructed. Because longer head-start periods cost more, finding the optimal head-starting duration will help develop more cost-effective head-starting programs. The research will also evaluate indoor-head-starting. If the increase in size also results in an increase in post-release survival compared to outdoor-reared animals, indoor head-starting could dramatically reduce the costs of rearing animals to releasable size and also increase production of head-starting facilities.	2a, 3a, 3b, 4f, 4g	The research team produced tortoise hatchlings in 2016 and 2017 and assigned them either to the indoor or outdoor experimental groups. The indoor group was raised indoors in their first year and then transitioned to outdoor pens for the second year of their head-starting. All captive tortoises were measured to track their growth rates in different treatments. In September 2018, the team released 78 juvenile tortoises and began post-release monitoring using radio telemetry. The project team is collaborating closely with a complementary project (EPC-16-053) in several areas, such as using a common technical advisory committee. They are also coordinating with US Fish and Wildlife Service and California Department of Fish and Wildlife to develop guidelines and management recommendations about this mitigation and recovery strategy.
EPC-16-039 A Life Cycle Assessment of the Environmental and Human Health Impacts of Emerging Energy Storage Technology Deployment	N/A	N/A	Yes; Calif Based Entity	This project provides guidance for California policymakers and planning agencies for selecting emerging energy storage technologies that can facilitate the increased uptake of renewable resources and decarbonization of California's energy system in a way that minimizes the externalities of environmental and human health impacts. This study is a first of its kind for flow battery technology and provides the knowledge base and understanding necessary to allow flow batteries to be deployed in a manner which alleviates or circumvents potential obstacles related to environmental and human health.	2a, 3e, 4b, 4c, 4d, 4e, 4f, 5d, 5e	The research team toured three flow battery manufacturing facilities (ESS, UET, Primus Power) and obtained inventory data for materials and energy use for all of them. In consultation with other literature sources the team developed a database for material use, energy use, waste, emissions, and costs associated with three different flow battery chemistries. Researchers also selected and evaluated indicators capturing the environmental impact of flow batteries and used preliminary results for the environmental impacts of the flow battery life cycle for initial comparison with that of a lithium-ion battery. In early 2019, the research team will begin to assess the maximum capacity deployment threshold for the three flow battery chemistries in order to identify the tipping point for net environmental benefits from their application.
EPC-16-040 Assessing Cooling Tower PM2.5 and PM10 Emissions using Advanced Instrumentation, Plume Transects, and Plume Modeling	N/A	N/A	Yes; Calif Based Entity	The research team is using plume measurements from fresh and brackish water cooling towers to develop a model of the droplet and particle size distribution changes in cooling tower plumes as a function of cooling water composition, meteorological conditions, and cooling tower operating parameters. The model will be based on first principles of chemistry and physics and validated using the measurement data. The model enables the use of brackish water instead of expensive fresh water, leading to decreased costs for electric utilities and ratepayers and freeing up more fresh water for use in homes, industry, and agriculture in California.	1c, 2a, 3a, 4b, 4c	The research team finalized the design of the instrument package for PM monitoring from cooling towers. The research team also identified two power plants for testing. The instrument package was installed on the cooling tower for one of the power plants in December 2018. Since both power plants will have a similar amount of total dissolved solids (TDS) in the circulating water, the team is working on identifying additional power plants with different TDS levels to test the different behaviors.
EPC-16-041 Benefits and Challenges in Deployment of Low GWP A3 Refrigerants in Residential and Commercial Cooling Equipment	N/A	N/A	Yes; Calif Based Entity	This project is evaluating alternative, low global warming potential (GWP) refrigerants that will also result in increased energy efficiency of cooling equipment. This project will identify current barriers and technical issues, and assess the potential for an expanded set of products which could use low GWP A3 refrigerants. The project will incentivize manufacturers to develop product prototypes that could be tested at the recipient's facility. This can help equipment manufacturers and vendors with product development and lead to an increase in the supply of equipment with much lower lifetime GHG emissions. By transitioning to refrigerants with lower GWP refrigerants, the state will see fewer GHG emissions from commercial and residential buildings over the next 10 - 30 years.	1f, 1h, 4a	The team has completed the literature review of alternative refrigerants for residential and commercial buildings. The recipient is preparing test plans to analyze cost savings, energy savings, GHG reductions, and efficacy of the A3 alternatives. The recipient expects to start testing equipment in 2019.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-042 Low-Cost High-Reliability Thermoelectrics for Waste Heat Conversion	Applied Research and Development	This project is developing a cost-effective mid- to high-temperature range (400-800C) p-type thermoelectric material for waste heat recovery using silicon nanowire arrays. The intent is to surpass technologies implementing an organic Rankine cycle or similar processes by having low parasitic losses, compact, and able to be modularized for a broad scale of distributed applications. To achieve the goal, the project will advance the state of the art in nanowire characterization; demonstrate an optimized process for the production of Si-nw arrays and a process to produce a freestanding array of aligned nanowires; characterize the thermoelectric and mechanical properties of these arrays and single Si-nw; optimize the fabrication of Si-nw arrays; and integrate into devices capable of heat-to-power conversion. The results of device performance will be used to evaluate the techno-economic impacts of this technology. Taken together, the project will move silicon nanowire technology's Technology Readiness Level (TRL) from 2 to a prototype technology demonstration in a relevant environment (TRL5).	4/12/2017	No	Generation	$2,000,000	$2,000,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-043 Cost-Effective and Climate Resilient In-Conduit Hydropower and Civil Works Innovation	Applied Research and Development	This project aims to scale in-canal hydropower retrofits by lowering project footprint and civil works costs. As most drop structures in irrigation canals have a consistent design, the goal is to design and implement a modular powerhouse and standard plant design that can be replicated across irrigation drops in California. Using a simpler and more easily scalable design will support the installation of the system to scale across the low-head sites identified across California with in-canal potential.	4/12/2017	No	Generation	$954,715	$954,715	$52,742	N/A	$52,742
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-044 Hyper Efficient Pump Motor Unit with Fully Integrated Permanent Magnet Motor and Motor Controls with Combined Liquid Cooling	Applied Research and Development	This project is developing an economical and efficient configuration for large scale integration and adoption of highly efficient liquid cooled permanent magnet motors, and fully integrated, liquid cooled motor controls. The goal is to use these technologies in the development of a smart pump motor unit that can quickly be commercialized and adopted statewide.	4/12/2017	No	Demand-side Management	$2,311,050	$2,311,050	$1,156,335	N/A	$1,156,335
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-045 Development of New Technologies for Agricultural Loads to Participate in Renewables Integration, RTP Programs, and/or New Time of Use Rates	Applied Research and Development	This project will result in the development of a smart irrigation control system that improves and expands on current remote irrigation pump switching technology. The technologies developed will provide growers with the ability to automate their preferred load control strategies in response to new time-of-use electricity rates. Beyond that basic capability, the systems facilitate automated response to utility and system operator demand response signals, enabling participation in current and future demand response and reliability programs. The system is being deployed and tested on multiple farms and multiple crop types in PG&E service territory in the Fresno area.	4/12/2017	No	Grid Operations/Market Design	$2,884,912	$2,884,912	$1,029,415	N/A	$1,029,415

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-042 Low-Cost High-Reliability Thermoelectrics for Waste Heat Conversion	$440,167	$0	The Board of Trustees of the Leland Stanford Junior University;	$516,502	20.5%	Grant	Pre-existing intellectual property identified in agreement EPC-16-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 1
EPC-16-043 Cost-Effective and Climate Resilient In-Conduit Hydropower and Civil Works Innovation	$0	$0	Natel Energy;	$954,715	50.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Natel Energy	Group 1: Ranked # 3
EPC-16-044 Hyper Efficient Pump Motor Unit with Fully Integrated Permanent Magnet Motor and Motor Controls with Combined Liquid Cooling	$99,350	$0	Terzo Power Systems, LLC.; Ansync Labs, Inc.;	$145,689	5.9%	Grant	Pre-existing intellectual property identified in agreement EPC-16-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Terzo Power Systems, LLC.	Phase 1 Group 1: Ranked # 2
EPC-16-045 Development of New Technologies for Agricultural Loads to Participate in Renewables Integration, RTP Programs, and/or New Time of Use Rates	$0	$0	Polaris Energy Services Inc.;	$649,485	18.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Polaris Energy Services Inc.	Phase 1 Group 2: Ranked # 2

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-042 Low-Cost High-Reliability Thermoelectrics for Waste Heat Conversion	N/A	N/A	Yes; Calif Based Entity	This project will address principal barriers to the widespread application of current thermoelectric materials by providing a low-cost, reliable, affordable and mass-producible technology that can be ubiquitously applied to convert high-temperature heat that is currently wasted at the production and retail levels in California.	1h, 3h, 4a	Since the project kicked off in September 2017, Alphabet Energy dropped out of the project forcing LBNL to seek a substitute. Stanford University has stepped forward as an alternate subcontractor responsible for manufacturing thermoelectric nanofibers. An amendment to add Stanford as a major subcontractor and extend the project term to recover lost time is currently in process.
EPC-16-043 Cost-Effective and Climate Resilient In-Conduit Hydropower and Civil Works Innovation	N/A	N/A	None	Greater reliability will be achieved by enabling greater penetration at significant total megawatts of new, distributed baseload renewable energy with predictable generation profiles. The project will also significantly reduce the capital cost of installing small hydropower in existing irrigation drop structures by reducing the cost of construction and civil works by an estimated 50 percent when compared with installing custom designed works and equipment for each site.	1a, 1b	The project kicked-off in July 2017. The project team has selected two sites for demonstration: Alder Drop in Yolo County, and Murphys Afterbay in Calaveras County. Interconnection applications for each project have been filed with PG&E and are under review. Natel currently seeking bids of EPC firms to manage construction, which is expected to take place in the second quarter of 2019. Natel also briefly reviewed a third possible demonstration site in the Banta-Carbona Irrigation District (San Joaquin County), but quickly determined the flows were inadequate to support a project. The Commission project manager has scheduled a critical project review to review project progress in February, 2019.
EPC-16-044 Hyper Efficient Pump Motor Unit with Fully Integrated Permanent Magnet Motor and Motor Controls with Combined Liquid Cooling	N/A	N/A	Yes; Calif Based Entity	This project could reduce the operating cost for hydraulic power systems by integrating an efficient permanent magnet motor, efficient motor controller, and a combined liquid cooling loop. Hydraulic power systems are found in nearly all industrial facilities.	1f, 1h	The recipient has completed reports on the Insulated-Gate Bipolar Transistor (IGBT) and Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) efficiency. Other tasks completed include testing with the hydraulic manifold and finalized machining work for aluminum housing for eventual thermal, hydraulic and electrical testing.
EPC-16-045 Development of New Technologies for Agricultural Loads to Participate in Renewables Integration, RTP Programs, and/or New Time of Use Rates	N/A	N/A	Yes; Calif Based Entity	For many electrical utilities, agriculture is a significant component of their peak load. Collectively there are between 160,000 and 170,000 irrigation pumps in the Central Valley. This project addresses the direct electricity cost of irrigation for agricultural customers and the indirect cost to all electricity ratepayers of procuring sufficient resources to meet marginal peak demand, integrating variable renewable energy generation, and building sufficient infrastructure to support agricultural pumping load peaks. The project goal is to develop control systems and operational strategies that can adapt to different rate designs--including dynamic and DR-program tariffs--by optimizing pumping loads across large numbers of irrigation pumps to me	1c, 1d, 1e, 1g, 1h, 3f	The project is on track. The project team has set up the irrigation control systems, and iteratively testing and improving the software control system and dispatch mechanisms with the active involvement of the growers to minimize disruption to the farming operation, avoid negatively impacting crop yields, minimize electricity costs, conserve water, and maximize flexibility in anticipation of greater opportunities for demand response participation in anticipation of expanded DR participation offerings from the utilities. The team is exploring the opportunity to incorporate a transactive component to their load management platform and is working with PG&E and SCE to develop an experimental tariff that would allow customers to increase participation and evaluate the application of real-time energy pricing to agricultural operations. Staff visited the site on December 5, 2018.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-046 Pilot Testing of Isothermal Compression	Applied Research and Development	Gas Technology Institute (GTI) and Carnot Compression LLC (Carnot) are developing and field testing a novel, near isothermal air compressor which will enable improved efficiency, maintenance and reliability. The unit will be tested at an industrial facility in southern California. This project hopes to reduce the energy consumption in industrial, water, agricultural, and commercial applications that require compression of air and other gases. This project demonstrates a more efficient compressor that will use less electricity to meet the same performance metrics of existing air and gas compressors. If successful, this project could improve the energy efficiency of compressed air/gas systems which are prevalent in all industrial processing facilities.	4/12/2017	No	Demand-side Management	$2,570,946	$2,570,946	$1,014,316	N/A	$1,014,316
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-047 California Biopower Impact Project	Applied Research and Development	This project develops an attributional life cycle assessment framework for various biomass-to-electricity supply chain and end-use scenarios that are specific to California. The research effort quantifies on a fine geospatial scale the amount of technically recoverable forest and agricultural biomass residue material in California, and it considers future impact projections from different climate change scenarios and fire risk probabilities under various harvest and land management scenarios. Based on the estimates, researchers are developing a detailed life cycle inventory - disaggregated by parcel, supply chain, and end-use characteristics. Results will support development of the California Residual Biomass-to-energy Carbon Accounting Tool (CARB-CAT) that will be made available to public and could inform policy decisions on the role of biomass residues in California's energy portfolio.	4/12/2017	No	Generation	$1,000,000	$1,000,000	$239,041	N/A	$239,041
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-048 Development and Testing of an Energy Efficient Ultra-low Charge Ammonia Refrigeration System in a Food Processing Plant	Applied Research and Development	This project is pilot testing and demonstrating an air-cooled, low-charge ammonia refrigerant-based, integrated package closed cooling system for an industrial food processing application. The project is demonstrating the effectiveness of a water-saving innovation with the use of a micro-channel, air-cooled condenser. The project is demonstrating the expected energy savings of 20% compared to a chiller using hydrofluorocarbon (HFC) refrigerant for similar end use at the same site. This system eliminates the need for water for cooling. The entire system can be prepackaged and factory charged, and brought to site as an integrated package which simplifies field installation and makes it cost effective.	4/12/2017	No	Demand-side Management	$2,406,054	$2,406,054	$304,488	N/A	$304,488
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-049 Ultra-High Power Density Roadway Piezoelectric Energy Harvesting System	Applied Research and Development	This project leverages a multidisciplinary system approach to investigate the energy recovery potential of dual-mode piezoelectric generators to create roadway piezoelectric energy harvesting systems with ultra-high power density and efficiency. The goal is to design and test a piezoelectric roadway energy harvesting system, consisting of multi-layer stack generators and power electronics, to capture over 50% of the compression mechanical energy as electricity from passing vehicles. This project will demonstrate electric power generation, in the laboratory and on a 95 feet x 12 feet section of a road at the UC Merced campus, and will determine feasibility for future large-scale demonstrations on highways and streets with piezoelectric under-pavement.	4/12/2017	No	Generation	$1,270,000	$1,270,000	$0	N/A	$0

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EPC-16-046 Pilot Testing of Isothermal Compression	$628,022	$0	Carnot Compression LLC;	$238,700	8.5%	Grant	Pre-existing intellectual property identified in agreement EPC-16-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Institute of Gas Technology dba Gas Technology Institute	Phase 1 Group 1: Ranked # 4
EPC-16-047 California Biopower Impact Project	$247,784	$0	Humboldt State University Sponsored Programs Foundation; Sierra Institute for Community and Environment;	$131,575	11.6%	Grant	Pre-existing intellectual property identified in agreement EPC-16-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Humboldt State University Sponsored Programs Foundation	Group 3: Ranked # 1
EPC-16-048 Development and Testing of an Energy Efficient Ultra-low Charge Ammonia Refrigeration System in a Food Processing Plant	$804,238	$0	Electric Power Research Institute, Inc.; TAKARA SAKE USA;	$605,000	20.1%	Grant	Pre-existing intellectual property identified in agreement EPC-16-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Electric Power Research Institute, Inc.	Phase 1 Group 1: Ranked # 5
EPC-16-049 Ultra-High Power Density Roadway Piezoelectric Energy Harvesting System	$310,100	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	University of California - Merced	Group 2: Ranked # 2

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EPC-16-046 Pilot Testing of Isothermal Compression	N/A	N/A	None	This near isothermal compressor, or Carnot Compressor, solves the heat of compression problem by using a working liquid to compress a gas, while actively removing the heat of compression throughout the compression process. By removing the heat throughout the compression step, the energy required to compress air from near atmospheric pressure to ~100 psig can be reduced by up to 50% compared to commercial air compressors, such as piston, screw, and scroll designs. These energy savings are expected to significantly improve the efficiency of industrial air applications.	1f, 1h	The project team finished the preliminary design of the isothermal compressor system and the design was discussed with team members during the first TAC meeting on October 10, 2018. The project is shifting focus towards finalizing the detailed design drawings and engaging with potential manufacturing firms for fabrication and assembly work of the prototype system, which is expected to be completed and operational by end of Q3 2019.
EPC-16-047 California Biopower Impact Project	N/A	N/A	Yes; Calif Based Entity	This research project develops a rigorous California-specific lifecycle emissions accounting framework for evaluation of various forest biomass residue mobilization scenarios, quantification of key potential environmental and climate impacts associated with biomass residue mobilization and conversion to electricity, and identification of potential pathways for offsetting biomass residue mobilization costs. The framework and Carbon Accounting Tool (CaRBCAT) will provide California policymakers with an evidence-based, spatially disaggregated, and probabilistic analysis to aid in creating policies aimed at managing the environmental performance of bioenergy systems. Ultimately, the results from this project will provide information on the topic of carbon neutrality of residual biomass-to-energy production	2a, 3a, 3g, 4a, 4b	The research team has conducted a net potential recoverable forest and agricultural residue assessment and compiled a spatially explicit database of these materials. The team has also developed a residual biomass-to-energy life cycle emissions accounting framework that considers various supply-chain and end-use scenarios for California. The team is publishing a beta version of an interactive accounting tool for GHG emissions from woody biomass converted to electricity in December 2018. In early 2019, the research team will continue working on the wildfire risk impact assessment, begin characterization of secondary environmental and climate impacts from woody biomass, and identify pathways for cost offsetting for biomass use.
EPC-16-048 Development and Testing of an Energy Efficient Ultra-low Charge Ammonia Refrigeration System in a Food Processing Plant	N/A	N/A	Yes; Calif Based Entity	An air cooled, low-charge, ammonia refrigerant based integrated closed-packaged system with semi-hermetic motor/compressor seal that eliminates the mechanical seal between the compressor and the motor is not available in the U.S market today. As this is a packaged product, this breakthrough will make it much easier for customers to implement this new technology and reap the energy and water savings benefits from it.	1e, 1f, 1h, 2a	The low-charge, packaged ammonia chiller installation was completed in February 2018 and is operating normally as confirmed by monitoring and verification data. Preliminary M&V results show that the ammonia chiller is 37.6 % and 48.8% more efficient than the R-507A chiller and the chiller and the pump (as a whole system), respectively. The Coefficient of Performance of the ammonia chiller is 4.87.
EPC-16-049 Ultra-High Power Density Roadway Piezoelectric Energy Harvesting System	N/A	N/A	Yes; Calif Based Entity	This project advances a piezoelectric energy harvesting system with ultra-high density and efficiency. Using an award-winning piezoelectric technology with unique dual-mode and multi-layer generator design and under-pavement installation strategy for smooth drive of passing vehicles and pedestrians, this project will help the ratepayers in California by reducing cost of electricity and reducing emissions related to power generation.	1e, 3h, 4a	The project has completed design and fabrication of a batch of multi-layer piezoelectric generators and metal frame, and has conducted laboratory evaluation of the prototype. The prototype design was revised and improved, resulting in promising relationship between the loading and displacement of the piezoelectric unit. An order to purchase 200 piezoelectric generator towers was issued.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-050 Scaling Reliable, Next-Generation Perovskite Solar Cell Modules	Applied Research and Development	Recent advances have pushed the solar conversion efficiency, making perovskites one of the most efficient solar technologies in existence. This project will use a scalable large-area manufacturing approach for fabrication of the perovskite solar absorber, the solar cell's transport and contact layers, and the encapsulation of the solar cell modules. The project will also include bifacial module design, where light enters from both front and back.	4/12/2017	No	Generation	$1,450,000	$1,450,000	$126,826	N/A	$126,826
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-051 Increased Energy Efficiency via Programmable Irrigation and Fertigation	Applied Research and Development	PowWow Energy, in collaboration with WiseConn Engineering, West Hills College Coalinga (WHCC) and UC Santa Barbara (UCSB), are developing an automated, programmable irrigation management system that integrates cutting-edge technologies to increase the energy efficiency of irrigation (defined as using less energy to achieve the same level of crop production). Pilot-scale tests of the integrated technology platform will be conducted at two sites on commercial farms located in disadvantaged communities: an almond orchard near Delano (AgWise Enterprises, SCE territory) and a field with a rotation of row crops (tomato, garlic, etc.) near Huron (Woolf Farming and Processing, PG&E territory).	4/12/2017	No	Demand-side Management	$2,992,660	$2,992,660	$896,978	N/A	$896,978
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-052 Force Multiplier Actuated Piezoelectric Energy Harvester for Roadway Energy Recovery	Applied Research and Development	The project develops, designs and installs a multitude of pavement-embedded devices to demonstrate energy harvesting from overpassing motor vehicles on the road in smart pavement covering 36 feet x 6 feet. The system consists of materials that exhibit the piezoelectric effect and result in generating an electric charge.	4/12/2017	No	Generation	$1,000,000	$1,000,000	$225,981	N/A	$225,981
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-053 Habitat Influences on Desert Tortoise Translocation Success	Applied Research and Development	The recipient is determining if habitat characteristics of the release sites can improve survival rates of smaller juveniles to the point that they are equivalent to the rates of the animals that were released only after reaching the desired size target. Careful measurement of resources that may help tortoises avoid predation or meet nutritional requirements will allow investigators to differentiate excellent habitat from merely adequate habitat. They are also studying the effects of outdoor rearing on juvenile desert tortoise behavior and health, and size-age relationships to survival in the wild upon their release. The project will generate quantitative, defensible information about the most cost-effective husbandry and release methods during and following a head-start program for this threatened species.	4/27/2017	No	Generation	$499,605	$499,605	$127,298	N/A	$127,298
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-054 Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services	Applied Research and Development	This project develops a "3-in-1" smart inverter, charging station, and building management system. The project focuses on defining and developing control algorithms to implement vehicle-to-grid (V2G) and vehicle-to-building (V2B) with minimal impact to the plug-in electric vehicle (PEV) battery life. This project develops and demonstrates the Smart Power Integrated Node (SPIN) device which is an off-vehicle, V2G power conversion and control device that can be applied to residential and small commercial applications. The system integrates a bidirectional direct-current (DC) PEV charger, photovoltaic inverter, and stationary storage battery, with an integrated local energy and power management system for power and energy management, grid communications, and ancillary services.	4/27/2017	No	Demand-side Management	$1,500,000	$1,500,000	$134,651	N/A	$134,651

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EPC-16-050 Scaling Reliable, Next-Generation Perovskite Solar Cell Modules	$184,540	$0	The Regents of the University of California, San Diego ;	$146,050	9.2%	Grant	Pre-existing intellectual property identified in agreement EPC-16-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	The Regents of the University of California, San Diego	Group 1: Ranked # 2
EPC-16-051 Increased Energy Efficiency via Programmable Irrigation and Fertigation	$341,285	$0	Environmental Studies Program and Bren School of Environmental Science and Management - UC Santa Barbara; PowWow Energy, Inc.; Aduro Accounting and Consulting, LLC; TBD Professional Services; WiseConn Engineering; West Hills College Coalinga; Mamala Research, LLC;	$350,547	10.5%	Grant	Pre-existing intellectual property identified in agreement EPC-16-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	PowWow Energy, Inc.	Phase 1 Group 1: Ranked # 1
EPC-16-052 Force Multiplier Actuated Piezoelectric Energy Harvester for Roadway Energy Recovery	$234,596	$0	Pyro-E, LLC;	$100,007	9.1%	Grant	Pre-existing intellectual property identified in agreement EPC-16-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	Pyro-E, LLC	Group 2: Ranked # 1
EPC-16-053 Habitat Influences on Desert Tortoise Translocation Success	$32,237	$0	Zoological Society of San Diego dba San Diego Zoo Global;	$390,528	43.9%	Grant	Pre-existing intellectual property identified in agreement EPC-16-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Zoological Society of San Diego dba San Diego Zoo Global	Group 2: Ranked # 1
EPC-16-054 Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services	$370,849	$0	Electric Power Research Institute, Inc.; Oak Ridge National Laboratory; National Renewable Energy Laboratory (NREL); Flex Power Control, Inc.;	$2,341,001	60.9%	Grant	Pre-existing intellectual property identified in agreement EPC-16-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1

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EPC-16-050 Scaling Reliable, Next-Generation Perovskite Solar Cell Modules	N/A	N/A	Yes; Calif Based Entity	Currently, encapsulated perovskite cells degrade in several hundred hours even in controlled low-oxygen and low-humidity conditions. This project integrates materials innovations developed to date at UC San Diego in the perovskite absorber layer, the solar cell's contact layers, and the encapsulation of the module to make breakthrough advances in perovskite solar cell reliability and scaling. Combining these materials together in a module assembly with glass on top and bottom slows degradation by a factor of 1,000. In addition, the bifacial design of module boosts its efficiency.	2a, 4a	The project team successfully transferred graphene atop perovskite layers, developed new electron transport layers, and is improving cell process by characterization and new absorber layer chemistry. The project team is now comparing the unencapsulated perovskite against the graphene barrier layer encapsulated perovskite cells. The project is growing crystals by using an electro-deposition approach.
EPC-16-051 Increased Energy Efficiency via Programmable Irrigation and Fertigation	N/A	N/A	Yes; Small Business, Calif Based Entity	This project integrates three new strategies for water and energy efficiency on farms (continuous pump testing with automated remote pump control, programmable irrigation for specific soil types and plant varieties, and management of water and fertility) with PowWow's software. If successful, this project could help individual farms realize energy, water and cost savings without affecting crop yield or quality.	1h, 4a, 4c	The project team is finalizing the summary reports for pilot sites and fieldwork for the 2018 experiments. The project team is working with University of California Santa Barbara to tabulate the results from the experiments to calculate savings in energy and water use efficiency as part of the measurement and verification report. Report is expected by early January 2019.
EPC-16-052 Force Multiplier Actuated Piezoelectric Energy Harvester for Roadway Energy Recovery	N/A	N/A	Yes; Calif Based Entity	The project demonstrates and assesses the potential of Regenerative Pavement technology, a roadway-embedded energy harvester that uses the untapped energy of car movements. The hardware devices developed using smart materials harvest energy from pavement deflections and vibrations under normal driving conditions. Simultaneously, energy performance data is collected to determine the technology's potential for widescale adoption in roadways and other surfaces.	1e, 2a	The project team completed basic design for the vibrational energy harvester, with a goal to maximize life under repeated impact and compression cycles from a vehicle. A batch of flexors, for converting vertical compression into horizontal extension, was fabricated and calibrated with force transducers and strain instruments to ensure proper specifications. A uniform subscale piezo-ceramic stack prototype was fabricated and assembled to prevent stress concentrations under buckling loads.
EPC-16-053 Habitat Influences on Desert Tortoise Translocation Success	N/A	N/A	Yes; Calif Based Entity	This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on Mojave Desert tortoises. This will be achieved by evaluating the relative effectiveness of head-start and release methods in an experimental framework. Improvements to the effectiveness of habitat management to encourage natural recruitment of juveniles will also be tested experimentally where possible.	2a, 3a, 3b, 4f	The project completed hatching of the first cohort of 63 hatchling tortoises at Edwards Air Force Base. This number should be sufficient for the 18-month old group to be released in 2020. Unfortunately, there was complete nest failure at the Cadiz site, so no hatchlings were produced there. With the advice and consent of the TAC and the agreement manager, researchers have a plan to overcome this setback with next year's cohort at Cadiz. They will attempt to collect a larger number of eggs in 2019 so that half could be reared indoors to reach the size the 18-month cohort would have achieved. The team is searching for a facility to conduct the indoor rearing. Investigating the cause of the nest failure should lead to improved guidance for future head-starting actions. The project team is collaborating closely with a complementary project (EPC-16-038), including using a common TAC.
EPC-16-054 Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services	N/A	N/A	Yes; Calif Based Entity	This project will determine the strategies and methodologies for V2G to become a value-added distributed energy resource (DER) asset to reduce ratepayer peak demand and defer grid upgrade costs. Results will inform investor-owned utilities on how V2G/V2B can be a viable resource to meet the Assembly Bill 2514 Storage Mandate and the CAISO energy storage and distributed energy resource initiative. The project will enable validation and valuation of the most effective use cases and intelligently aggregate distributed energy resources to enable and accelerate V2G/V2B charging and discharging strategy adoption to alleviate constrained distribution system nodes.	1c, 1e, 2a, 3f, 4a, 5b	The project team defined the SPIN functional requirements and interface protocols for bidirectional power flow, renewable energy generation, and battery energy storage management and control integration. The team developed software and interface architecture using the defined priorities and roles of the SPIN controller and the building management system/microgrid controller. The project team also developed the aggregator and distribution system operator server to send test demand response signals and smart inverter commands to the SPIN emulator. The team integrated the transformer management system (developed under EPC-14-086) to aggregated multiple SPIN systems.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-055 Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers	Applied Research and Development	The project enables day-ahead and real-time pricing for DC fast charging by developing an integrated hardware and software platform to reduce demand charges from DC fast charging and address intermittency and renewable energy over-generation issues. The site controller and network-based platform advances smart and efficient charging by managing four multi-port fast charging stations to minimize grid impact and lower the cost of operating fast chargers, evaluates suitability of DC fast charging to participate in demand response programs, and develops and evaluates advanced technologies to efficiently integrate second-life PEV batteries for demand management with DC fast charging. By addressing intermittency and renewable energy over-generation issues, the project will reduce grid impact and increase renewable penetration in the grid by aggregating four DC fast charging stations with stationary battery storage from second-life PEV batteries.	4/27/2017	No	Demand-side Management	$826,250	$826,250	$388,196	N/A	$388,196
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-056 Performance Evolution, Specification and Verification of Building Control Sequences	Applied Research and Development	The project is developing a design tool that can be integrated with OpenStudio and similar design software. The goal is to develop an integrated set of tools to enable design engineers to use energy-efficient ASHRAE-developed or custom control sequences for commercial buildings, specify them for control providers, and then verify their correct implementation. The project is expected to reduce the time to specify, implement and verify the proper operation of control sequences. Use of the design tool could enable more efficient building operations and reduce operating costs.	5/10/2017	No	Demand-side Management	$1,000,000	$1,000,000	$204,265	N/A	$204,265
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-057 Development of Smart Charging Infrastructure Planning Tool (SCRIPT)	Applied Research and Development	This project develops the Smart Charging Infrastructure Planning Tool (SCRIPT) that produces spatial-temporal forecasts of electric vehicle (EV) charging demand and flexibility. SCRIPT will determine daily predictive smart charging strategies that foresee the future travel needs of drivers and grid conditions. SLAC is studying the role of different charging infrastructure investment strategies in the effectiveness of EV smart charging techniques to accommodate state level renewable penetration goals in California. SLAC will test the tool using real-time charging data to determine the maximum amount of solar generation that can be absorbed by the vehicles through smart charging. SLAC will also study the trade-offs between investing in new charging infrastructure compared to better management of existing infrastructure via smart charging.	5/10/2017	No	Demand-side Management	$1,500,000	$1,500,000	$660,641	N/A	$660,641
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-058 Advanced Transit Bus VGI Project	Technology Demonstration and Deployment	This project addresses critical real-world needs to commercialize and scale electric transit fleets with robust grid-serving energy services. Leveraging Santa Clara Valley Transit Authority's (VTA) plan to purchase up to 35 all-electric buses to electrify its 500-bus fleet, the project team will demonstrate strategies to improve the business case of e-buses, including reducing cost via advanced management, establishing revenue generation opportunities, addressing commercial fleet management needs, and ensuring benefits reach all communities by delivering e-bus transit to underserved communities.	5/10/2017	No	Demand-side Management	$1,899,199	$1,899,199	$292,649	N/A	$292,649

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-055 Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers	$0	$0	Zeco Systems dba Greenlots;	$302,008	26.8%	Grant	Pre-existing intellectual property identified in agreement EPC-16-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Zeco Systems dba Greenlots	Group 1: Ranked # 1
EPC-16-056 Performance Evolution, Specification and Verification of Building Control Sequences	$473,633	$2,170,000	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Lawrence Berkeley National Laboratory	N/A***
EPC-16-057 Development of Smart Charging Infrastructure Planning Tool (SCRIPT)	$328,945	$0	UC Santa Barbara; ChargePoint, Inc.;	$94,193	5.9%	Grant	Pre-existing intellectual property identified in agreement EPC-16-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)	Group 1: Ranked # 2
EPC-16-058 Advanced Transit Bus VGI Project	$0	$0	Santa Clara Valley Transit Authority; Proterra Inc.;	$1,035,018	35.3%	Grant	Pre-existing intellectual property identified in agreement EPC-16-058 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Prospect Silicon Valley	Group 4: Ranked # 4

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-055 Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers	N/A	N/A	None	This project is advancing the aggregation of DC fast chargers to optimize vehicle charging from either the grid or the stationary battery storage based on the day-ahead and real-time pricing data from the electric utility to reduce grid congestion and mitigate renewable energy over-generation. This optimization will lower the cost of EV charging, directly translating into cheaper PEV charging for the ratepayers and increase PEV penetration.	1e, 1h, 2a, 4a	The project team has completed development, testing, and integration of the demand response functionality into Greenlot's SKY (cloud) platform. Greenlots is building the base platform and algorithms to support the hardware integration. Smart charging algorithm performance testing and optimization on multiple level 2 PEV chargers is ongoing.
EPC-16-056 Performance Evolution, Specification and Verification of Building Control Sequences	N/A	N/A	Yes; Calif Based Entity	This federal cost share grant with the US Department of Energy, will develop open source tools to enable verification of building control strategies and will integrate building controls, lighting and HVAC with the smart grid to provide fast and slow demand response. The breakthrough will be that designers can use pre-tested ASHRAE building control sequences or custom sequences, adapt and optimize, and test their impact on energy, peak power reduction, indoor air quality and thermal and visual comfort. The control sequences can be exported to the control vendor to obtain cost estimates and can be used by commissioning agents to verify that the original design intent is realized. This will enable accountability for controls performance between design and operation and is expected to have broad adoption and impact.	1f, 3a, 3b, 3f, 4a	This project is more than halfway complete. The recipient has collected data on a case study at Oracle and will develop additional sequence verifications between the collected data and controls description language.
EPC-16-057 Development of Smart Charging Infrastructure Planning Tool (SCRIPT)	N/A	N/A	Yes; Calif Based Entity	There are significant benefits from workplace smart charging that may be shared with the vehicle owners. By exercising the flexibility of the vehicle charging in the workplace, commercial customers can save from energy and demand charge costs. Smart charging can decrease energy charges by up to 1.5% of the overall utility bill, and decrease demand charges by up to 24.7%. Further benefits can be achieved from adding PV to the distributed energy resource at a site, even without that addition, there is significant benefit to both the EV owner and workplace where the EV is being charged.	1e, 1f, 3a, 3f, 4a, 5b	SLAC's Smart Charging Infrastructure Planning Tool (SCRIPT) project is in the data ingestion phase, using a ChargePoint dataset encompassing commercial and residential EV charging history from 2015-2018 in the San Francisco Bay Area that will be integrated in the visualization and Analytics of Distributed Energy Resources (VADER) platform to inform SCRIPT. In addition, a task focused on time series analysis will be performed on the EV demand and flexibility data to produce forecasts produced from a model which takes user input scenarios for varying EV growth, travel demand growth, and regional goals. The forecasts will enable a smart charging algorithm to be developed that will determine the optimal charging scenario for each aggregation of charging equipment, maximizing solar charging and minimizing costs (e.g. electricity, infrastructure expansion) while meeting driver mobility needs.
EPC-16-058 Advanced Transit Bus VGI Project	N/A	N/A	Yes; Calif Based Entity	The project will make the following advances: translate automotive VGI advancements to a commercial e-bus fleet, including retail and wholesale energy services; deliver advanced optimization of battery life and cyber security; integrate energy services and management with leading commercial fleet management tools; integrate key Energy Commission funded VGI platforms and provide a roadmap for statewide deployment.	2a, 4a, 4b	The team installed charging stations to support the first five electric buses added to Santa Clara Valley Transit Authority's fleet. The team completed development of the e-bus integration and acceptance test plan and developed a preliminary analysis of the impacts of a complete e-bus fleet. The team is now focused on developing the Energy Management Platform which will serve the smart charging needs of the electric fleet and be used to determine best practices for wide scale adoption.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-059 Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Service and Renewable Power Penetration	Applied Research and Development	This project demonstrates an automated control system for a fleet of PEVs and repurposed second-life batteries that reduces the overall cost of ownership by maximizing battery lifetime, shifting load to reduce electricity and demand charges, and providing V2G and V2B services, including those supporting the use of onsite solar generation. The demonstration adds a stationary second-life battery installation to the existing PEV fleet site at the Los Angeles Air Force Base.	5/10/2017	No	Demand-side Management	$1,500,000	$1,500,000	$701,533	N/A	$701,533
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-061 Intelligent Electric Vehicle Integration (INVENT)	Technology Demonstration and Deployment	This project is deploying vehicle-grid integration (VGI) technology with unidirectional and bidirectional power flow capabilities using light fleet and consumer vehicles. These vehicles will provide local grid support by controlling the charge rate based on energy and power capacity available locally, controlling the voltage, and providing grid-wide support by participating in frequency regulation or adjusting the reactive power. The mix of services provided will be optimized within a campus laboratory setting with the goal of expanding this technology into a real-world setting.	6/14/2017	No	Distribution	$4,200,000	$4,200,000	$706,488	N/A	$706,488
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-062 Advancing Demand Response in the Water Sector	Applied Research and Development	This project is developing a demand management system to optimize energy use and operations using the Moulton Niguel Water District as a pilot site. By better optimizing its system, the water utility will be able to reduce its energy bill by participating in demand response and load shifting incentive programs. The project will optimize load for the potable and recycled water systems at Moulton Niguel while developing a software platform and management system that can be easily adopted by other water districts and utilities.	5/10/2017	No	Demand-side Management	$2,984,983	$2,984,983	$95,959	N/A	$95,959
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-063 Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning	Applied Research and Development	This project develops new and better ways of merging the two approaches, using both weather forecast models (more generally called dynamical models) and inferences from past history (statistical models). The combined method is called a hybrid dynamical-statistical approach for inferring fine-resolution climate information from the coarse-resolution global climate models. Ideally, the hybrid approach will be able to capture many of the physical processes simulated by the costly weather forecast models, but with the reduced expense of statistical models. The hybrid approach will be applied to three key areas of California's climate that have important implications for the state's ratepayers: wind, clouds, and hydrology: wind, clouds, and hydrology.	4/27/2017	No	Grid Operations/Market Design	$1,399,888	$1,399,888	$19,077	N/A	$19,077
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-064 Investigating Avian Attraction to Solar Energy Facilities Through a Lake Effect	Applied Research and Development	Researchers are exploring the behavior of attraction by birds to solar facilities, particularly in relation to the "lake effect" hypothesis. Specifically, they are studying 1) the ability of birds to detect potentially attractive visual cues associated with solar facilities (e.g., polarized light, irradiance); 2) the corresponding change in flight behavior characteristic of movement toward solar facilities; and the 3) mortality and natural history of birds that actually occupy solar facilities. First, the recipient is examining the sensory basis of attraction through field and lab experiments. Second, radar and thermal imaging are used to measure the degree to which birds alter their flight paths to settle at solar facilities. Data on behavior and mortality from multiple solar facilities are gathered to inform a statistical model to determine what characteristics of solar facilities and species' natural history together explain variations in mortality exhibited across sites.	5/10/2017	No	Generation	$499,785	$499,785	$252,200	N/A	$252,200

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-059 Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Service and Renewable Power Penetration	$407,071	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 2
EPC-16-061 Intelligent Electric Vehicle Integration (INVENT)	$0	$0	The Regents of the University of California, San Diego; Strategen; Nuvve Corporation; FleetCarma;	$3,697,744	46.8%	Grant	Pre-existing intellectual property identified in agreement EPC-16-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Nuvve Corporation	Group 4: Ranked # 5
EPC-16-062 Advancing Demand Response in the Water Sector	$282,171	$0	Moulton Niguel Water District; Helio Energy Solutions;	$105,765	3.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	36 out of 36 bidders	Regents of the University of California, Davis	Ranked # 3
EPC-16-063 Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning	$192,928	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	University of California, San Diego Scripps Institution of Oceanography 0955	Group 6: Ranked # 1
EPC-16-064 Investigating Avian Attraction to Solar Energy Facilities Through a Lake Effect	$177,072	$0	United States Geological Survey; Western EcoSystems Technology, Inc.; Humboldt State University Sponsored Programs Foundation; NRG Energy, Inc.; NextEra Energy; Bard College; 8minuteenergy Renewables, LLC; First Solar; Recurrent Energy;	$740,251	59.7%	Grant	Pre-existing intellectual property identified in agreement EPC-16-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	US Geological Survey	Group 1: Ranked # 1

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EPC-16-059 Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Service and Renewable Power Penetration	N/A	N/A	Yes; Calif Based Entity	This project is developing and implementing an optimization and control algorithm for a fleet of PEVs and stationary battery packs that includes impacts on battery health expressed as an economic cost, using models and parameters derived from actual battery measurements. These activities will help demonstrate PEV ownership lifecycle cost reductions and will advance scientific knowledge of the impacts of V2G and V2B services on mobile and second-life PEV batteries.	1h, 3f, 4b	Thirteen existing charging stations have been retrofitted to support testing. Also, as of November 2018, 10 charging stations are up and running; the remaining three charging stations will be in service soon. The research team designed the sensor package to measure battery temperature and state of charge in the PEVs and developed an approach to estimate and predict battery degradation.
EPC-16-061 Intelligent Electric Vehicle Integration (INVENT)	N/A	N/A	None	This project is developing an advanced VGI technology to optimize the blend of unidirectional charging, bidirectional operation, and vehicle-to-building functions, for different real world grid applications such as frequency regulation, power quality, voltage control, and grid support. The project will show the value of EVs as distributed energy resources, with the ability to defer or eliminate the need for grid upgrades, and enable greater renewable energy penetrations.	1h, 3f, 4b	The project team installed 18 Phase I charging stations on the UC San Diego campus. The team then completed commissioning of the unidirectional and bidirectional chargers and vehicles. Testing included manual charging and discharging of EVs to demonstrate the functional performance of the chargers and vehicles. The unidirectional chargers were tested on 8 vehicles including BMW i3, Chevy Bolt, Tesla Model 3, Smart cars, and the UCSD facilities' EV fleet. The bidirectional chargers were tested of the 9 bidirectional (VG2) units with Nissan LEAFs and a Mitsubishi Outlander, which have V2G capabilities. The team has begun to assess the impact of the vehicles on the UC San Diego demand charges and is beginning simulation of frequency control with the system.
EPC-16-062 Advancing Demand Response in the Water Sector	N/A	N/A	Yes; Calif Based Entity	The demand management system uses real-time energy analytics to: (1) reduce and/or shift peak energy loads, (2) account for different energy tariff structures, and (3) balance the grid's intermittent renewable load generation. This demand management tool enables water utility participation in demand response and load shifting utility programs. Along with marketing and communicating the technology, the tool will inform other water utilities, and could result in increased use and acceptance. Given the impact of energy consumption by the water industry in California responsible for 10% of the state's electricity demand, widespread use of the proposed methodology could help achieve energy demand reduction needed to support the state's energy goals.	1e, 1g, 1h, 2a, 3h, 4a	The team has developed a hydraulic model of the Moulton Niguel Water District water system that will be used to develop and test energy management strategies. The team is also refining data and inputs to the energy demand management system software, including gathering tariff and grid operation characteristics information from the utilities and the California Independent System Operator. The research team has completed a Hydraulic Model Display and Results Report which contains a full analysis of the reclaimed and potable hydraulic models at the water utility.
EPC-16-063 Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning	N/A	N/A	Yes; Calif Based Entity	The project will include an extensive quantification/measurement (model validation) effort, which will be based on data from observed meteorological stations and existing coastal upwelling indices (for wind), satellite records of low cloudiness compiled by project members (for cloudiness and aerosols), and USGS stream-flow and groundwater observations (for the hydrologic modeling). The method under development could be used for California's Fifth Climate Change Assessment and future energy planning.	5c	This project started late in the summer of 2017. The research team is running dynamic regional climate models and exploring the use of statistical models for hourly simulations. In the past, climate scenarios for California only included projections with daily resolution. The Energy Commission's Energy Forecast Office is moving towards hourly forecasts
EPC-16-064 Investigating Avian Attraction to Solar Energy Facilities Through a Lake Effect	N/A	N/A	None	This project is the first systematic study to determine whether birds are attracted to solar energy facilities and if so, to develop an understanding of the sensory basis and proximal response of birds to solar facilities in relation to the "lake effect" attraction phenomenon. Following from that new understanding, the project will identify potentially viable methods for deterring birds from approaching solar facilities and informing future siting decisions in ways that reduce the likelihood of birds encountering solar facilities.	2a, 3a, 4f, 4g	This agreement was approved at the May 2017 business meeting, but the agreement could not be executed until March 2018. The first field season of data collection was successfully completed for both radars at the Desert Sunlight Solar Facility, and bird carcass search, and bird use surveys at several additional solar photovoltaic facilities across southern and central California. These data are being analyzed. The experimental tasks to study bird attraction to polarized surfaces is in the planning and preparation stages.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-065 California E-Bus to Grid Integration Project	Technology Demonstration and Deployment	This project focuses on improving the economics of incorporating e-buses in a transit agency fleet. The project team is working with the Antelope Valley Transit Authority (AVTA) to evaluate multiple potential benefits, including smart charging, improving vehicular energy efficiency through best driving practices, and using the vehicle batteries for grid services when the E-buses are not being used for their routes. More effective smart charging reduces the frequency and duration of in-route charging, and the fuel economy improvements that come from smart driving result in operational cost savings. By reducing the likelihood that several/all E-buses will be charging at once, the smart charging platform will achieve greater flexibility to mitigate demand charges and provide grid services.	5/10/2017	No	Grid Operations/Market Design	$3,327,953	$3,327,953	$794,005	N/A	$794,005
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-067 Robust Super Insulation at a Competitive Price	Applied Research and Development	Heating and cooling represents the greatest energy consumption in buildings. This project is developing thermal building insulation material with high R-value at a cost commensurate with conventional insulation materials. The product is expected to provide a significant increase in energy savings for existing buildings.	6/14/2017	No	Demand-side Management	$100,000	$100,000	$27,890	N/A	$27,890
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-068 Integrated Community-Level Solutions for Resource Management for a Grid and Customer Benefits	Applied Research and Development	This project demonstrates the feasibility of using an integrated community-scale solar plus storage system, sited at a low income multi-family disadvantaged community in Willowbrook, CA, as a distribution asset. The technology solution balances a combination of grid-connected distributed energy resources (DER), including advanced solar PV, energy storage, smart inverter, demand response, and load management. The project team is working with Southern California Edison to study the distribution grid impacts that the DERs can mitigate, realizing cost savings and enabling increased PV penetration. It is also investigating innovative business strategies to maximize the value of DER to both end-users and the utility. Another objective of the project is to demonstrate a cost-effective solution to achieving Zero Net Energy (ZNE) within an affordable housing community to realize California's 2020 goal for new sustainable and scalable ZNE communities.	6/14/2017	No	Demand-side Management	$2,976,991	$2,976,991	$119,351	N/A	$119,351
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-070 Integrating Front-of-the-Meter Energy Storage with Smart PV Inverters and Solar Forecasting	Technology Demonstration and Deployment	The purpose of this agreement is to design and install front-of-meter energy storage with smart PV inverters and solar forecasting. The research will demonstrate a cost-effective and scalable solution that integrates distributed energy resources to address grid needs and identify costs reductions and revenue generating opportunities for developers and commercial customers.	6/14/2017	No	Demand-side Management	$1,832,770	$1,832,770	$93,320	N/A	$93,320

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-065 California E-Bus to Grid Integration Project	$0	$0	Antelope Valley Transit Authority;	$3,729,000	52.8%	Grant	Pre-existing intellectual property identified in agreement EPC-16-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Zero Net Energy (ZNE) Alliance	Group 4: Ranked # 1
EPC-16-067 Robust Super Insulation at a Competitive Price	$42,679	$1,600,000	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Lawrence Berkeley National Laboratory	N/A***
EPC-16-068 Integrated Community-Level Solutions for Resource Management for a Grid and Customer Benefits	$821,664	$0	Electric Power Research Institute, Inc.; Southern California Edison; OhmConnect, Inc.; Chai Energy; E-GEAR; EPC Power; Nextek; Prism Solar;	$1,002,900	25.2%	Grant	Pre-existing intellectual property identified in agreement EPC-16-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1
EPC-16-070 Integrating Front-of-the-Meter Energy Storage with Smart PV Inverters and Solar Forecasting	$0	$0	Electric Power Research Institute, Inc.; Craig Wooster Engineering;	$591,438	24.4%	Grant	Pre-existing intellectual property identified in agreement EPC-16-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 6: Ranked # 1

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EPC-16-065 California E-Bus to Grid Integration Project	N/A	N/A	Yes; Micro Business, Minority Owned	E-Buses have the technical and economic potential to rapidly displace diesel and CNG transit buses given current replacement cycles. Buses are being deployed with onboard telematics to understand the vehicle's operating health and parameters, and high-power wireless inductive charging is now a viable solution for in-route charging. Together, these technologies help overcome range limitations and uncertainty. However, while these technologies alone provide great value and overcome key adoption barriers, integrating them with analytics and distributed energy resource (DER) management platforms will unlock even greater value.	2a, 3f, 4a	The team is working with AVTA on the installation and tracking of the Health Alert Management System (HAMS) electronic components as they are procured by AVTA. The HAMS will provide data essential to monitoring E-bus performance and identifying problems with E-bus operation. The team also installed two wireless chargers for the buses to test the ability to deploy them to more easily charge the buses when not in motion (e.g., at bus stops). The team created a model that will allow them to evaluate different use cases to identify the best revenue streams for the AVTA E-buses. The team is working on a driver training module to optimize the driver behavior for best energy efficiency results in assigned routes.
EPC-16-067 Robust Super Insulation at a Competitive Price	N/A	N/A	Yes; Calif Based Entity	Currently, there is no thermal building insulation material that can cost-effectively be assembled with high R-values. This Department of Energy cost share agreement is developing a manufacturing process to achieve a high R-value and decrease the installed thickness of the insulation, at a competitive price. This will make retrofits easier because much less space will be needed to accommodate existing building wall assemblies.	1h	The team is currently in the material testing phase, examining options to increase the flexibility of the insulation. Future work will involve analyzing the effects of nanoparticles on the thermal transport process, in order to estimate the insulating properties of the tested materials.
EPC-16-068 Integrated Community-Level Solutions for Resource Management for a Grid and Customer Benefits	N/A	N/A	Yes; Calif Based Entity	The project includes high efficiency bifacial 355W solar modules that can substantially assist commercial and multifamily buildings with roof area constraints, as well as the integration of solar and storage with smart inverters that include segmentation of storage for meeting multiple needs. The project also demonstrates a platform that can manage both loads and storage while integrating DC mini grids to eliminate conversion losses for solar PV.	1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a, 3f, 4a, 4b	The Energy Commission issued a Stop Work Order (SWO) on August 31, 2018, since EPRI failed to execute a subcontract agreement with LINC Housing. As a direct result, this also delayed the execution of a subcontract between LINC Housing and Gridscape Solutions, which is directly responsible for designing, building, and developing control interfaces, performing laboratory testing, commissioning, and deploying the solar + storage system. The Stop Work Order was removed in December 2018. EPRI has completed the Final Measurement and Verification Plan. An order was placed to procure (2) 110 kWh energy storage system and (4) 30kW inverters with an anticipated delivery by December 15, 2018.
EPC-16-070 Integrating Front-of-the-Meter Energy Storage with Smart PV Inverters and Solar Forecasting	N/A	N/A	Yes; Calif Based Entity	The project will demonstrate an interoperable solution that integrates front-of-the-meter energy storage with smart PV inverters and satellite-based solar forecasting to address grid limitations. The idea is to enable PV as a grid asset through beneficial integration with storage, capacity management, and communications. To accomplish this, advanced modeling techniques will be used including EPRI's existing tools for hosting capacity calculation and energy storage value simulation. Advancements that will result from this demonstration will enable aggregated DER control and optimization.	1a, 1e, 3a, 4a	EPRI has completed an analysis of the front of the meter storage envisioned in this project, including a detailed assessment of the value streams associated with this option. This work has generated valuable learnings in multiple areas: challenges with the interconnection process for front-of-the-meter storage; interconnection costs; compatibility of the proposed approach with the California Public Utility Commission framework on multi-user applications for storage; and technical challenges related to backup services and metering. The team is currently designing the system.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-073 Valencia Gardens Energy Storage	Technology Demonstration and Deployment	The purpose of this project is to utilize energy storage in front of the meter to increase the ability of the distribution grid to support more local solar, while improving overall grid operations and economics. This project will provide a replicable model for California by demonstrating multiple uses: interoperability with normal grid operations, including participation in existing wholesale market opportunities; and enhanced interconnection hosting capacity to accommodate far more local solar; and indefinite solar-driven backup power for prioritized loads. Additionally, this project will recommend advancements in policy, interconnection processes, and market mechanisms that maximize and recognize the full value of local energy storage deployments that are interconnected in front of the meter.	6/14/2017	No	Demand-side Management	$1,994,687	$1,994,687	$413,328	N/A	$413,328
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-077 Solar+ Storage Integrated Energy Management Demonstration in a Supportive Housing Facility	Applied Research and Development	The project deploys a 100 kW high-performing solar PV system, a 150 kW/150 kWh li-ion battery energy storage system, and an advanced energy management platform (smart inverter) to demonstrate the advancement of these technologies compared to standard commercially available products. These components will be integrated to optimize flexibility in demand side energy management through Load Shifting, Solar PV Self-consumption, Emergency Back-Up, Demand Response, and Ancillary Grid Services. The proposed system will be able to autonomously meet demand response and energy management requests while critical loads at the building are maintained, minimizing operational impacts.	6/14/2017	No	Demand-side Management	$2,110,657	$2,110,657	$75,374	N/A	$75,374
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-079 Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration	Applied Research and Development	This project will comprehensively evaluate the Phase III functions. The process will include computer modeling of California distribution circuits for economic analysis, implementation of Phase III functions in multiple inverter brands, laboratory testing, and field pilot testing. An economic analysis will build on the technical findings from the computer modeling, identifying the impact to the asset owner, performing an economic valuation of these impacts, and providing guidance regarding potential compensation. A comprehensive cyber security assessment of the communication system will be performed and public key infrastructure will be established to support the cyber security needs in California.	6/14/2017	No	Grid Operations/Market Design	$2,935,822	$2,935,822	$312,940	N/A	$312,940
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-001 Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions	Technology Demonstration and Deployment	This project optimizes and simplifies control upgrades (HVAC and lighting) to demonstrate energy savings while also improving occupant comfort by using automated fault detection and diagnostics, continuous commissioning, and advanced measurement and verification procedures. The team will use the results to develop recommendations for strategies, tools, and initiatives to address market barriers and promote large scale market adoption.	7/12/2017	No	Demand-side Management	$2,966,716	$2,966,716	$546,900	N/A	$546,900

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-073 Valencia Gardens Energy Storage	$0	$0	PATHION, INC;	$620,470	23.7%	Grant	Pre-existing intellectual property identified in agreement EPC-16-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Natural Capitalism Solutions, dba Clean Coalition	Group 6: Ranked # 2
EPC-16-077 Solar+ Storage Integrated Energy Management Demonstration in a Supportive Housing Facility	$332,995	$0	LINC Housing Corporation; Regents of the University of California, Riverside Campus; EnSync Energy Systems; EnerBlü;	$411,509	16.3%	Grant	Pre-existing intellectual property identified in agreement EPC-16-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Regents of the University of California, Riverside Campus	Group 1: Ranked # 3
EPC-16-079 Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration	$0	$0	Electric Power Research Institute, Inc.; SunSpec Alliance; Sunrun;	$1,659,077	36.1%	Grant	Pre-existing intellectual property identified in agreement EPC-16-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 4: Ranked # 1
EPC-17-001 Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions	$932,257	$0	Trane U.S., Inc.; United States Department of Energy; Automated Logic Corporation; Siemens Corporation, Corporate Technology; Kaiser Permanente Medical Center; Enlighted Inc.; Delos; KGS Buildings; Alerton;	$2,773,750	48.3%	Grant	Pre-existing intellectual property identified in agreement EPC-17-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Taylor Engineering	Group 1: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-073 Valencia Gardens Energy Storage	N/A	N/A	None	This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of California's statutory energy goals by utilizing energy storage as a local balancing and optimization solution on a circuit in the distribution grid. The project will demonstrate a combination of advancements and breakthroughs including, but not limited to an advanced local energy system that utilizes energy storage on a circuit to optimize local circuit balancing, increases PV hosting capacity, and provides the California Independent System Operator with ancillary services.	1e, 1h, 4a, 5b	The project team developed the detailed design of the system and received approval of the Self Generation Interconnection Agreement with PG&E to demonstrate an in-front-of-the-meter energy storage system. Additionally, the interconnection agreement process was completed in November. The team also completed the site preparation and installation planning.
EPC-16-077 Solar+ Storage Integrated Energy Management Demonstration in a Supportive Housing Facility	N/A	N/A	Yes; Calif Based Entity	This project integrates energy storage and PV technology with advanced control algorithms and smart inverter autonomous functions. The solar+ system uses high efficiency solar panels DC coupled with Li-ion battery storage and demonstrate various smart inverter functions to provide autonomous grid services and energy management practices under a variety of operational conditions. The team is assessing the impact smart inverter-provided grid services and solar + storage operation have on each other. The project provides BESS and PV technology integrated with an energy management system to support diurnal energy loads. This project implements utility initiated DR functions and creates an architecture that allows expansion to future power regulation and potential wholesale market participation.	1c, 1d, 1e, 1g, 1h, 2a, 3d, 3f, 3h, 5a	Agreement has been placed under stop work order while the City of Long Beach is reviewing LINC Housing's building permit application. Once a building permit has been approved by the City, the stop work order may be lifted. LINC Housing anticipates their building permit application being approved by January 2019.
EPC-16-079 Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration	N/A	N/A	Yes; Calif Based Entity	This project will help overcome three major barriers to achieving the state's energy goals by: 1) proving that CA Rule 21 Phase III functions can be deployed feasibly, safely and predictably via standardization; 2) demonstrating that grid penetration levels can be increased by 25% or more via use of the Phase III advanced control functions; and 3) enabling secure, scalable and affordable cyber security infrastructure that can make the grid safer and more reliable.	1a, 1b, 5a, 5b, 5f, 5g	In 2018, the project team completed all the distribution system modeling and tested the effectiveness of Phase III functions to increase hosting capacity by 25% on a diverse set of California distribution circuits. Many roadblocks were overcome including challenges encountered in recruiting industry vendors to implement Phase III functions within the project timeline. Two commercial inverter brands implemented Phase III functions and they are currently undergoing laboratory testing at The University of California, San Diego. The laboratory testing is a precursor to a field test planned at 50 residential locations to evaluate the IEEE 2030.5 communication protocol at the utility interface.
EPC-17-001 Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions	N/A	N/A	Yes; Small Business, Calif Based Entity	This project will help achieve the State's energy goals by scaling up the market adoption of control retrofits that result in significant energy savings in commercial buildings. The successful demonstration of scalable, plug-and-play integrated packages of HVAC and lighting controls will allow commercial building owners and operators to maximize energy savings across large portfolios of buildings while reducing transaction costs.	1f, 1h	Progress this year includes securing four test sites, getting stakeholder feedback through technical advisory meetings, conducting pre-installation work, and initiating field installations. The project team is also actively planning market transformation activities to promote large scale market adoption once the technologies have been successfully demonstrated.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-002 Scaling Solar+ for Small and Medium Commercial Buildings	Applied Research and Development	The research team is designing, implementing, operating, and evaluating a Solar+ system in a pilot scale application for convenience stores. The project is designed to innovate across three key priority areas necessary for technology scale-up: hardware design guidelines, integration software, and site targeting. Filling these knowledge gaps will help move the deployment of Solar+ technologies forward, thereby bringing substantial benefit to individual building owners, as well as opening opportunities to provide service to the broader distribution and bulk power systems. This project focuses on the convenience store/fueling station SMB sector, but lessons learned and products developed can likely be extrapolated to other SMB sectors.	7/12/2017	No	Demand-side Management	$1,500,000	$1,500,000	$410,568	N/A	$410,568
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-003 Developing a Comprehensive, System-Wide Forecasting to Support High-Penetration Solar	Applied Research and Development	This project provides CAISO with an improved next-minute to day-ahead high resolution, system-wide, probabilistic power production forecast for all California PV systems. The comprehensive forecast includes both behind-the-meter and utility-scale PV systems. The project is quantifying the costs and benefits of these improvements. The team uses mid-term DER adoption forecasts adapted from the IOUs' DRPs to project distribution of DERs into the future. The team is combining the result with the improved PV forecast to integrate results into CAISO load forecasts using Itron's load forecast engine.	7/12/2017	No	Generation	$750,000	$750,000	$323,524	N/A	$323,524
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-004 Enhanced Modeling Tools to Maximize Solar + Storage Benefits	Applied Research and Development	This research is developing a solar + storage optimization tool to evaluate the dispatch, operations, and value proposition for integrated solar + storage systems. The tool is capable of evaluating distributed solar with storage and an array of advanced controls and dispatchable DER technologies, and it evaluates optimal dispatch for a wide range of customer programs and incentives. The tool is currently being used to evaluate the EPIC funded solar + storage systems awarded under the Solar + solicitation. It's also designed to integrate into the California Public Utility Commission (CPUC) Distributed Resource Planning (DRP) process with discussions on utilizing this in the Distribution Investment Deferral Framework (DIDF) which require the IOUs to issue the Distribution Deferral Opportunities Report (DDOR) to be vetted by the Distribution Planning Advisory Group (DPAG) to identify candidate projects that should be issued for competitive solicitation.	7/12/2017	No	Demand-side Management	$987,379	$987,379	$624,005	N/A	$624,005
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-005 Integrating Building-Scale Solar + Storage Advanced Technologies Maximizing Value to Customer and the Distribution Grid	Applied Research and Development	This project assesses the performance and benefits of integrated solar photovoltaic and storage along with advanced energy efficiency and demand response / distributed energy resources management technologies in a commercial building setting. The goal is to leverage the synergies of integrated and controllable components to improve distribution grid stability and reliability while also enabling the commercial customer to reduce both capital costs and operational and management costs for optimal value.	7/12/2017	No	Distribution	$1,491,764	$1,491,764	$92,693	N/A	$92,693

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EPC-17-002 Scaling Solar+ for Small and Medium Commercial Buildings	$413,443	$0	Southern California Edison; Humboldt State University Sponsored Programs Foundation; Tesla Motors, Inc.; Serraga Energy, LLC at Blue Lake Rancheria;	$345,242	18.7%	Grant	Pre-existing intellectual property identified in agreement EPC-17-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Humboldt State University Sponsored Programs Foundation	Group 2: Ranked # 2
EPC-17-003 Developing a Comprehensive, System-Wide Forecasting to Support High-Penetration Solar	$176,606	$0	State University of New York at Albany; Clean Power Research, L.L.C.;	$320,000	29.9%	Grant	Pre-existing intellectual property identified in agreement EPC-17-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Clean Power Research, L.L.C.	Group 5: Ranked # 1
EPC-17-004 Enhanced Modeling Tools to Maximize Solar + Storage Benefits	$457,030	$0	San Diego Gas and Electric Company; Southern California Edison; Energy and Environmental Economics, Inc. (E3); Starboard Energy Advisors, LLC;	$108,655	9.9%	Grant	Pre-existing intellectual property identified in agreement EPC-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Energy and Environmental Economics, Inc. (E3)	Group 3: Ranked # 1
EPC-17-005 Integrating Building-Scale Solar + Storage Advanced Technologies Maximizing Value to Customer and the Distribution Grid	$360,079	$0	Electric Power Research Institute, Inc.;	$271,090	15.4%	Grant	Pre-existing intellectual property identified in agreement EPC-17-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-17-002 Scaling Solar+ for Small and Medium Commercial Buildings	N/A	N/A	Yes; Calif Based Entity	This project will integrate DER, energy storage, and controllable loads to increase the value of Solar+ systems in the SMB sector. Optimized relative sizing of batteries to PV and flexible operations from model-predictive control (MPC)-enabled building automation will demonstrate how investment in an integrated system can save costs and create efficiency compared to standalone PV and storage. The project will develop and demonstrate an open-source MPC algorithm with hierarchical control awareness of embedded, distributed control logic to manage building systems and improve load control. Improved hardware-software interfaces will integrate the solar PV system with localized energy storage and MPC-improved load control systems. This will allow SMB owners to optimize the benefits of distributed solar and approach net-zero energy buildings while also supporting the larger grid power system.	1c, 1e, 1f, 1h, 1i, 2a, 3d, 3h, 5a, 5f	As of November 2018, the solar PV panel array has been fully installed on the gas station canopy. LBNL is currently developing the Model Predictive Controller and testing for this control software will begin soon. The switchgear will be delivered early 2019 and the Tesla battery is scheduled to be delivered by March 2019. The complete solar + storage system is planned to be fully commissioned by May 2019.
EPC-17-003 Developing a Comprehensive, System-Wide Forecasting to Support High-Penetration Solar	N/A	N/A	Yes; Calif Based Entity	This project advances the state of PV forecasting in California by improving the accuracy of solar irradiance and PV forecasts, particularly rooftop solar, which is not currently well-understood. Participants in the Energy Commission's January 2017 forecasting workshop identified the lack of visibility into DER impacts on net load as a major barrier to generating accurate forecasts. Forecast inaccuracies cost California millions of dollars annually and result in the unnecessary curtailment of renewable generation.	1c, 2a, 3a, 5c	The first Critical Project Review meeting was held on August 28, 2018. Since then, Energy Commission staff has reviewed and approved the final reports for the PV Forecast Accuracy Improvement and the DER Production Database tasks. Energy Commission staff is coordinating with staff from CPUC and the California Solar Initiative DG Stats website to post the DER Production Database data and report in a way that will provide the greatest visibility to the data and allow it to be used by others. CPR has also submitted the draft reports for the Irradiance Forecast Accuracy Improvement and the CAISO Integration Report tasks. CPR anticipates completing both of these final reports by December 2018. CPR anticipates completing the draft reports for the Time-Dependent Forecast Error Valuation Methodology and the DER Adoption Forecast Impact tasks in the first quarter of 2019.
EPC-17-004 Enhanced Modeling Tools to Maximize Solar + Storage Benefits	N/A	N/A	Yes; Small Business, Calif Based Entity	This project is developing a tool, in consultation with the three large IOUs, that will enhance the existing Local Net Benefits Analysis (LNBA) tool developed by the Recipient under the CPUC's DRP. It's capable of simulating the operations of DER under different tariff and program designs and determining the new designs that align the best uses of DER to the customer with the best uses of DER for the grid that will maximize the benefits of DER to ratepayers. The current planning tools do not consider how different tariff and program designs will affect DER locations and adoption rates that will affect system reliability and cost. There are discussions on utilizing this tool in the DIDF process to target the cost-effective DER to those locations that provide the highest utility and ratepayer benefits.	1a, 1b, 1c, 2a, 3b	E3 has submitted four iterations (as planned) of the Solar + Storage Tool, with each iteration incorporating feedback and comments from TAC Members. E3 has also hosted multiple meetings, has provided a walkthrough of Tool functionalities, and is collaborating with the recipients of three EPIC agreements (16-070, 16-073 and 17-002) on collecting data and demonstrating the Tool in various use cases. The final version of the Tool is anticipated for completion by March 2019 and will incorporate additional feedback from TAC Members and the "lessons learned" from the three EPIC agreements listed.E3 has proposed multiple public workshops and webinars, with the first anticipated in March 2019, to demonstrate how the Solar + Storage Tool can provide a robust, regulatory grade cost-benefit analysis of DER programs and also how it can influence the design of DER programs to maximize net benefits.
EPC-17-005 Integrating Building-Scale Solar + Storage Advanced Technologies Maximizing Value to Customer and the Distribution Grid	N/A	N/A	Yes; Calif Based Entity	For California to achieve its long term greenhouse gas reduction goals, there is a greater need for flexibility at all levels of grid operations. This project will demonstrate a suite of DER technologies, including solar + storage, with the capability for active and reliable control of customer owned loads and resources in order to a) reduce the building owner's energy bill and b) reduce the need to build new transmission and distribution infrastructure that is typically required to compensate for high loads and customer-side generation.	1h	The Energy Commission is currently processing a site change amendment. The original site, a wholesale coffee roasting warehouse in Oakland, was not suited to fully demonstrate all of EPRI's planned technology, and the owner backed out of the agreement. The amendment will move the project site to the San Francisco Bay Area Council (SFBAC) of the Boy Scouts of America, located in a disadvantaged community in San Leandro, CA. The new site has a commercial building load profile that varies between weekday load and weekend load. This will demonstrate the flexibility of Intech's building controller. At this new site, EPRI will be able to fully demonstrate all the technologies captured in their project agreement.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-006 Development, Implementation, and Integration of a Holistic Solar Forecasting System for California	Applied Research and Development	The project develops an improved forecasting system for solar irradiance in California, with a particular focus on fog and stratus conditions, through targeted deployment of instrumentation. The improved forecasts will be integrated into operational tools for use by the California Independent System Operator (CAISO) and utilities. This project utilizes a targeted instrumentation network, consisting of existing and new sensors, to improve the models used for forecasting fog and stratus conditions. The Recipient will design and deploy this network with the aim of improving the forecasts that are most important to CAISO and/or utility operations.	7/12/2017	No	Grid Operations/Market Design	$749,740	$749,740	$30,785	N/A	$30,785
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-007 Integrated Community Solar and Storage at a Low Income Mobile Home Park	Applied Research and Development	The Center for Sustainable Energy (CSE) is applying high efficiency solar and storage technologies to create an integrated community solar and storage energy system at a low income mobile home park in Bakersfield, California. The project illuminates operational strategies for storage to provide clear value propositions to end-use customers with existing tariff structures and demonstrate alternate structures and additional value streams that can increase the value of storage to the end customer while better achieving distribution system operational goals.	7/12/2017	No	Grid Operations/Market Design	$2,005,923	$2,005,923	$35,805	N/A	$35,805
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-008 Empowering Energy Efficiency in Existing Big-Box Retail/ Grocery Stores	Technology Demonstration and Deployment	This project demonstrates the impact of an integrated suite of pre-commercial energy efficiency technologies in a large, existing, retail building located near a disadvantaged community. One of the technologies that comprise the installation package includes a novel supervisory controller to provide system-wide optimization, to reduce electricity consumption across numerous building subsystems, including lighting, refrigeration, and heating, ventilation, and air-conditioning (HVAC). This could enable site electricity savings of greater than 20%.	7/12/2017	No	Demand-side Management	$2,824,685	$2,824,685	$247,899	N/A	$247,899
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-009 Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California)	Technology Demonstration and Deployment	This project demonstrates three innovative bundles of pre-commercial technologies. The technology bundles were strategically developed through a systems-level approach to address the most energy-intensive areas in commercial buildings. These include: (1) Chilled Water Plants: Optimized all-variable-speed chilled-water (CHW) plants utilizing alternative refrigerant chillers. (2) Office and Exterior Space LED fixtures with integrated advanced controls, advanced building management system (BMS), and plug load controls controllable for demand response (DR), and off-grid, exterior, LED lighting in the parking lot, and lastly (3) Advanced laboratory ventilation, fume hood exhaust, and direct current (DC) lighting systems.	7/12/2017	No	Demand-side Management	$3,994,256	$3,994,256	$182,447	N/A	$182,447
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-010 Integrated Heat and Moisture Calculation Tool for Building Envelopes	Applied Research and Development	The project is developing processes and supporting software to enable more efficient building operations and reduce costs. The goal is to develop a set of tools that can be integrated with EnergyPlus/OpenStudio or similar design tools. The tools will enable design engineers to use energy-efficient ASHRAE-developed or custom control sequences for commercial buildings and verify their correct implementation. The project is expected to reduce the time to specify, implement and verify the proper operation of control sequences.	8/9/2017	No	Demand-side Management	$125,000	$125,000	$25,000	N/A	$25,000

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-006 Development, Implementation, and Integration of a Holistic Solar Forecasting System for California	$365,395	$0	Electric Power Research Institute, Inc.; Sonoma Technology, Inc.; AWS Truepower, LLC;	$324,830	30.2%	Grant	Pre-existing intellectual property identified in agreement EPC-17-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 5: Ranked # 2
EPC-17-007 Integrated Community Solar and Storage at a Low Income Mobile Home Park	$499,016	$0	Resident Owned Parks, Inc.;	$340,905	14.5%	Grant	Pre-existing intellectual property identified in agreement EPC-17-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Center for Sustainable Energy	Group 1: Ranked # 2
EPC-17-008 Empowering Energy Efficiency in Existing Big-Box Retail/ Grocery Stores	$686,589	$0	Southern California Edison; Robert Bosch LLC; Integrated Comfort; Software Motor Corporation; Walmart; Apana, Inc.; Transformative Wave; SmartGreen;	$759,984	21.2%	Grant	Pre-existing intellectual property identified in agreement EPC-17-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Center for Sustainable Energy	Phase 2: Ranked # 3
EPC-17-009 Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California)	$875,037	$0	Trane U.S., Inc.; ASWB Engineering; Willdan Energy Solutions; Aris Wind;	$2,382,225	37.4%	Grant	Pre-existing intellectual property identified in agreement EPC-17-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Willdan Energy Solutions	Phase 2: Ranked # 2
EPC-17-010 Integrated Heat and Moisture Calculation Tool for Building Envelopes	$59,000	$1,375,175	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Lawrence Berkeley National Laboratory	N/A***

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-17-006 Development, Implementation, and Integration of a Holistic Solar Forecasting System for California	N/A	N/A	Yes; Calif Based Entity	The use of an advanced network of existing and new instrumentation to inform numerical weather and statistical model improvements will significantly improve the current state of solar forecast modeling in California. The holistic forecasts produced will showcase a combination of various aspects of the weather forecast value chain, not previously demonstrated, linking observation systems and advanced physical and statistical modeling for solar forecasting. The project's focus on fog and marine layer forecasts, which are traditionally challenging to predict, assures that these issues are well-understood in advance of increased PV penetration in the coming years.	1b, 2a	Researchers are collecting real-time data from instrumentation at all project sites, which is posted every 30 minutes on a real-time website developed to support the field measurement program. The website provides an interface for visualizing, reviewing, and quality-assuring sensor data. The team has set up and performed a series of experiments using the WRF (Weather Research and Forecasting) numerical weather prediction model to test the sensitivity of the model's ability to forecast foggy conditions. Researchers also developed a code to convert observations from a network of meteorological sensors into a format that is readable by the WRF Data Assimilation module to allow the measurements to improved forecasts of fog and low clouds that affect day-ahead and other short-term solar generation forecasts for electric utilities and grid operators.
EPC-17-007 Integrated Community Solar and Storage at a Low Income Mobile Home Park	N/A	N/A	Yes; Calif Based Entity	This project is designing, installing, and evaluating integrated high-efficiency solar panels with energy storage batteries, along with low-cost control hardware to demonstrate the impact of an integrated community solar and energy storage system in a low-income community. The project is designed to demonstrate the impact of an integrated community solar and energy storage system in a low-income community, which is expected to reduce net energy consumption and reduce energy bills.	3h	The kickoff meeting was held on January 31, 2018. In June, CSE discovered Horizon Solar Power (subcontractor) did not budget for paying its workers prevailing wage. In July 2018, this project was placed under stop work order until CSE finds a replacement subcontractor. Before being placed under stop work order, subcontractor Kisensum had begun to prototype the optimization algorithm necessary to manage the onsite storage and develop unit tests for Tesla battery controls.
EPC-17-008 Empowering Energy Efficiency in Existing Big-Box Retail/ Grocery Stores	N/A	N/A	Yes; Calif Based Entity	This project demonstrates how pre-commercial energy efficient technologies can deliver cost-effective, deep electric savings in a big-box retail environment, while also showcasing the demand reduction potential of these strategies. To overcome barriers associated with the package, the team resolves and documents identified system integration and operational challenges. Additionally, rigorous M&V and extensive energy modeling quantifies beneficial technology synergies.	1f, 1h, 2a, 3a, 4c	The team has completed baseline monitoring and pre-installation characterizations for the site. In 2019, the team will model and install efficient retrofit packages at the site which include LED lighting, HVAC, and refrigeration upgrades.
EPC-17-009 Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California)	N/A	N/A	Yes; Calif Based Entity	The demonstration project offers an innovative approach applicable to a range of commercial buildings. This strategy will accelerate adoption of energy savings technologies, contributing to reaching the state's energy efficiency and GHG reduction goals. By demonstrating this comprehensive approach in a real-world application this research has the potential to lead to further scale up and adoption of similar technology packages in other government and commercial buildings.	1f, 1h, 3b	The team recently completed the measurement and verification plan and the engineering design of the various energy efficiency packages. The first phase of the project, a retrofit of the HVAC chiller system, is set to begin in early 2019.
EPC-17-010 Integrated Heat and Moisture Calculation Tool for Building Envelopes	N/A	N/A	Yes; Calif Based Entity	The cost-effective modeling tool will enable improved envelope designs for new construction and retrofit applications, thus increasing building energy efficiency. As this project is jointly funded with the US Department of Energy, the developed tools have the potential to be broadly disseminated which could further the advancement of the developed software	1f, 1h	The team is currently testing the tool and receiving feedback from a group of reviewers using an alpha version of the software. The recipient has completed a detailed data management plan. The DOE's quarterly assessments show the project is generally on track, there are no major concerns, and the project continues to hold strong promise

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-011 Demonstration of an Innovative, Community-Scale, Organic Waste-to-Energy Facility	Technology Demonstration and Deployment	The goal of the project is to construct and demonstrate operation of an innovative, state-of-the-art anaerobic digestion facility converting organic waste from San Luis Obispo County into renewable electricity. The facility is the first of its kind of dry digester technology to be installed in the U.S. and is expected to process about 36,500 tons of food waste and urban waste into 6.2 million kWh per year of renewable electricity, 13,000 tons of compost and 1.6 million gallons of liquid fertilizer leading to a host of environmental (e.g. reduction of 5,300 MT CO2e per year), economic, reliability, and safety benefits.	8/9/2017	No	Generation	$4,000,000	$4,000,000	$292,517	N/A	$292,517
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-012 Biomass-to-Electricity: Pilot-Scale Testing of Baseload Compared to Flexible Power	Applied Research and Development	The project tests and evaluates three different energy pathways for conversion of woody biomass to electricity. The three pathways tested with the pilot-scale gasifier system are: 1) clean fuel gas production for baseload power generation, 2) syngas to Fischer-Tropsch liquid production for storage and flexible power generation, and 3) direct bio-crude production for storage and flexible power generation. Results from the three pathways will be compared and an optimal pathway will be identified for extended testing. After performing extended testing of the optimal pathway the technical, environmental, and economic performance of a full-scale facility will be evaluated.	7/12/2017	No	Generation	$1,499,000	$1,499,000	$868,228	N/A	$868,228
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-013 Small Scale Forest Waste Power System	Applied Research and Development	This project develops a pilot-scale modular biomass power system called Altex Forest Power Technology (FORPOWER) that uses biomass from forest management as fuel to generate renewable electricity. FORPOWER, which is based on an indirectly fired gas turbine technology that separates the fuel combustion products from the clean gas turbine working fluid by using a novel heat exchanger, uses forest slash as a renewable fuel while meeting criteria pollutant requirements, reducing greenhouse gas emissions, supporting renewable energy goals, and improving forest sustainability. The Altex FORPOWER will cost effectively convert forest slash to electric power and interconnect with the grid at distributed locations within IOU regions that are close to forest resources.	7/12/2017	No	Generation	$1,499,994	$1,499,994	$1,145,533	N/A	$1,145,533
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-014 Advanced Plug Load Controls and Management in the Educational Environment	Technology Demonstration and Deployment	This project deploys APMD technology over a large sample size, at approximately 55,000 computer workstations at several Community Colleges, and focuses on integrating the technology with facility operations to ensure that they meet the needs of the sites and staff. Key features of the proposed project include outreach and individual education programs to California Community College Districts, evaluation of sites for participation in the project, purchase and installation of APMDs at approved sites, measurement and verification (M&V) activities both pre- and post-APMD implementation at the selected demonstration sites, and stakeholder satisfaction information from demonstration facilities staff and APMD end-users through interviews and surveys.	8/9/2017	No	Demand-side Management	$5,000,000	$5,000,000	$423,978	N/A	$423,978

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-011 Demonstration of an Innovative, Community-Scale, Organic Waste-to-Energy Facility	$0	$0	HZIU Kompogas SLO Inc.;	$5,278,373	56.9%	Grant	Pre-existing intellectual property identified in agreement EPC-17-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	HZIU Kompogas SLO Inc.	Group 3: Ranked # 1
EPC-17-012 Biomass-to-Electricity: Pilot-Scale Testing of Baseload Compared to Flexible Power	$254,980	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Taylor Energy	Group 1: Ranked # 2
EPC-17-013 Small Scale Forest Waste Power System	$768,611	$0	Altex Technologies Corporation; The Avogadro Group, LLC;	$161,728	9.7%	Grant	Pre-existing intellectual property identified in agreement EPC-17-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Altex Technologies Corporation	Group 1: Ranked # 4
EPC-17-014 Advanced Plug Load Controls and Management in the Educational Environment	$181,567	$0	Ibis Networks; Embertec;	$2,422,770	32.6%	Grant	Pre-existing intellectual property identified in agreement EPC-17-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Newcomb Anderson McCormick, Inc.	Phase 2: Ranked # 4

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EPC-17-011 Demonstration of an Innovative, Community-Scale, Organic Waste-to-Energy Facility	N/A	N/A	None	This project will benefit California ratepayers by demonstrating an innovative, state-of-the-art anaerobic digester facility. Once economical operation is proven, similar facilities can be replicated across California to provide similar benefits to other local communities.	1a, 1b, 1c, 2a, 3a, 3b, 3g, 3h, 4a	Construction of the anaerobic digester (AD) facility in San Luis Obispo has been completed in October 2018 and facility began taking green waste. First samples of biogas have been produced and cleaned using hydrogen sulfide (H2S) removal system that has been commissioned on site. H2S removal system allows to store biogas on site. A grand-opening ceremony was held on November 14, 2018. During the first quarter of 2019, the recipient will finalize the Source Testing Plan in collaboration with SLOAPCD allowing the facility to accept organic food waste. The combined heat and power unit is fully installed and ready to deliver electricity from combusted biogas to the grid, once the interconnection agreement with PG&E is fully executed, also expected during the first quarter of 2019.
EPC-17-012 Biomass-to-Electricity: Pilot-Scale Testing of Baseload Compared to Flexible Power	N/A	N/A	Yes; Calif Based Entity	This project will test and evaluate new biomass-to-energy pathways which is critical to meeting several of California's energy goals and provides numerous economic, environmental, and safety benefits to California ratepayers.	2a, 3a, 3b, 3e, 4a	The project conducted its kickoff meeting in September 2017. The project team has completed initial system modifications and has performed testing of the first pathway - clean fuel gas production for baseload power generation. The project team is performing system modifications required for testing of the other two pathways.
EPC-17-013 Small Scale Forest Waste Power System	N/A	N/A	Yes; Calif Based Entity	Integrating a low cost feedstock densification approach and innovative heat exchanger with gasifer and externally fired gas turbine to efficiently generate electricity from forest slash will provide multiple benefits to California IOU electricity ratepayers including reduced power cost relative to alternative approaches and improved electric power generation reliability while reducing the risk of forest fires and pollutant emissions and creating economic development opportunity near the forest region.	1a, 2a	FORPOWER densification and bioenergy modules buildup and testing are ahead of schedule. The buildup of these pilot-scale test modules was originally planned for February 2019. To date, the densification module buildup has been completed and log production has been successfully tested for pine, fir and cedar forest residues. The bioenergy module buildup has also been completed and checkout testing of components is continuing during this period. Forest slash from UC Berkeley Blodgett Station were collected and processed ready for testing in the bioenergy module. A recent staff availability situation hindered their ability to fire the unit on biomass. However, the project is still planning to initiate bioenergy module biomass testing ahead of the planned start date of March 2019.
EPC-17-014 Advanced Plug Load Controls and Management in the Educational Environment	N/A	N/A	Yes; Calif Based Entity	Significant electricity consumption and cost savings will be delivered to the participating Community College Districts via the implementation of the APMD technology. These savings will begin to accrue as the devices are deployed in a phased approach, and be fully achieved once the EPIC project is complete. Following project completion, the APMD systems will continue to provide savings throughout their 8 to 10 year expected useful life. Successful deployment at participating Districts will then be leveraged to expand technology adoption throughout the remainder of the California Community College system.	1f, 1h, 2a	The two equipment vendors, Embertec and Ibis Networks, have completed training of California Conservation Corps staff on correct installation of their devices. In 2018 the project team installed advanced plug load devices at 8 community colleges and the remaining devices will be installed at the other participating colleges in 2019.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-015 Installation and Soft Cost Reduction for Horizontal Single Axis Trackers (Stage II)	Technology Demonstration and Deployment	This project is demonstrating a novel single axis solar PV tracking system. The innovative tracking system which can fit on sloped and rolling terrain will help solar developers build projects on lands closer to load centers and interconnection points that typically would not be considered, creating more site options. The construction costs are dramatically reduced by eliminating the need for grading soil with reduced environmental damage and mitigation costs. The new tracker was developed through a DOE award and a full-scale system is under testing at a rolling terrain near Davis. The Energy Commission grant is funding improvements and testing of the various tracker components in an effort to find cost-cutting opportunities to update the product design and optimize it for full-scale manufacturing.	8/8/2017	No	Generation	$999,822	$999,822	$310,882	N/A	$310,882
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-016 An Online Siting Tool Application for Woody Biomass-to-Electricity Facilities in California	Applied Research and Development	This project develops a decision support system that will reduce the soft costs of estimating and planning new bioenergy power plants that consume woody biomass from sustainable forest management activities. The open-source facility-siting tool will be hosted online and will allow users to quickly evaluate economic feasibility and environmental performance potential of particular locations for developing a wood-based biomass power plant. The project includes case study analysis to understand feasibility and barriers to developing biopower facilities in high-risk hazard zones.	8/9/2017	No	Generation	$1,222,284	$1,222,284	$74,471	N/A	$74,471
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-017 The Nexus of Clean Energy, Healthy Forests, and a Stable Climate: Innovative Biomass Gasification for Sustainable Forest Management	Applied Research and Development	This project supports the development of the Powertainer+, (PT+) a multi-modal power and products platform designed to generate low-cost renewable energy, process thousands of tons of forestry waste derived from California's unprecedented tree die-off, and sequester large amounts of carbon. The Powertainer+ will include a combined heat and power module, increase the power capacity (from 150kW to between 210-250kW) and increase the forestry waste processing capacity to up to 2200 (twenty-two hundred) bone dry tons per year.	10/11/2017	No	Generation	$1,500,000	$1,500,000	$475,744	N/A	$475,744
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-018 Demonstrating the Potential for On-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units	Technology Demonstration and Deployment	This project assesses the potential for a highly standardized and rapidly deployable decentralized AD solution as a compelling alternative to large-scale centralized AD facilities. By implementing on-site AD at locations where food waste is generated and electricity demand exists, it is possible to reduce/avoid 1) the consumption of non-renewable electricity, 2) the transmission and distribution (TandD) losses associated with the delivery of electricity across long distances on the regional grid, and 3) the transport costs (inclusive of the monetary, environmental, and public health costs) of hauling food waste long distances to feed larger AD generators.	9/13/2017	No	Generation	$2,411,007	$2,411,007	$29,549	N/A	$29,549

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-015 Installation and Soft Cost Reduction for Horizontal Single Axis Trackers (Stage II)	$76,846	$2,999,364	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Nevados Engineering, Inc.	N/A***
EPC-17-016 An Online Siting Tool Application for Woody Biomass-to-Electricity Facilities in California	$203,977	$0	Regents of the University of California (University of California, Davis);	$28,523	2.3%	Grant	Pre-existing intellectual property identified in agreement EPC-17-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	The Regents University of California, Davis	Group 1: Ranked # 3
EPC-17-017 The Nexus of Clean Energy, Healthy Forests, and a Stable Climate: Innovative Biomass Gasification for Sustainable Forest Management	$0	$0	Humboldt State University Foundation, Schatz Energy Research Center; All Power Labs, Inc.; Anderson Biomass Complex;	$750,000	33.3%	Grant	Pre-existing intellectual property identified in agreement EPC-17-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	All Power Labs, Inc.	Group 1: Ranked # 1
EPC-17-018 Demonstrating the Potential for On-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units	$171,649	$0	UC Davis; Biodico, Inc.; SeaHold, LLC;	$756,133	23.9%	Grant	Pre-existing intellectual property identified in agreement EPC-17-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	The Regents University of California, Davis	Group 3: Ranked # 2

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EPC-17-015 Installation and Soft Cost Reduction for Horizontal Single Axis Trackers (Stage II)	N/A	N/A	Yes; Calif Based Entity	The Nevados All Terrain Tracker is a single axis tracker with a unique mechanical structure, similar to the driveshaft in a pickup truck, which provides a mounting surface for solar modules that is elevated about four feet off the ground, and which rotates slowly throughout the day to follow the sun. The technology meets market requirements by providing a proven and high-quality product that meets UL-3703 safety requirements, achieving a pricing level that is competitive for the industry, and opening up 3-10X the amount of land that was previously unavailable. Solar project developers benefit directly by being able to complete more projects in less time for less money. Consumers benefit from having access to lower-cost clean energy and by replacing polluting energy generation technologies with clean-energy alternatives.	1e, 2a, 3a, 3b, 4a	Multiple pitches to project developers, as well as financial validation of the supply chain, have identified numerous opportunities to install solar power projects where they were previously considered impossible to install. Nevados team built a strong supply chain to achieve the pricing and quality necessary to sell to the market and has entered the commercial market in 2018 with a UL-listed product that had been tested extensively. Two projects have been installed during the award period. These advancements were made possible through funding from the Department of Energy and the California Energy Commission.
EPC-17-016 An Online Siting Tool Application for Woody Biomass-to-Electricity Facilities in California	N/A	N/A	Yes; Calif Based Entity	This project will increase the cost competitiveness of biopower plant projects, resulting in expanded opportunities for using biomass waste streams. The online and open application architecture will ensure that everyone has open, public and equal access to this resource.	1a, 1b, 1c, 3b, 3h, 4a, 5d, 5e	The forestry bioenergy siting tool project is on schedule. The spatial analysis of tree mortality task is on track to be completed by December 2018. Invitations to participate in the TAC were sent out to prospective members. The first TAC meeting will be held on January 8, 2019, tentatively at the California Energy Commission.
EPC-17-017 The Nexus of Clean Energy, Healthy Forests, and a Stable Climate: Innovative Biomass Gasification for Sustainable Forest Management	N/A	N/A	Yes; Calif Based Entity	Broadly, the goals of this project are to decrease the modular technology platform's Levelized Cost of Electricity, increase its forestry residue processing capacity, add new value streams in the forms of hot water and biochar production, and enhance the system's carbon sequestration capacity.	1a, 1f, 3g, 4a, 4e	The project team designed and prototyped a small pre-combustion biochar offtake test bench and gasifier test bench to better profile the production and quality of biochar produced and started to prepare components for the engineering validation testing (EVT). The gasifier architecture enables pre-combustion biochar takeoff and allows experimentation with different orientations in the cracking annulus. Components of the CHP module, such as the in house producer gas and exhaust heat exchangers, are being designed, prototyped and tested before the EVT. Due to the exhaust heat exchanger design, the flare is considered a separate emission unit because it needs to operate constantly. Thus, the project team needs to prepare an amended air quality permit for the increased usage of flare. The CHP architecture is the primary pathway in which the system efficiency will be improved.
EPC-17-018 Demonstrating the Potential for On-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units	N/A	N/A	Yes; Calif Based Entity	This project addresses the knowledge gap regarding the optimal scale for the deployment and use of AD technology to convert food waste into renewable electricity, heat, and fertilizer. To meet this need, researchers will perform techno-economic and environment assessments of increased deployment of micro-scale AD systems across the state. Researchers will also develop new information about the performance variability of micro-scale AD systems relative to fluctuating and heterogeneous food waste feedstock inputs.	1a, 1b, 2a, 3b, 3g, 4a, 4e	Because the US Navy withdrew from the project, UC Davis (UCD) has moved the project site from Naval Base Ventura County to Lineage Logistics, a cold storage facility in Oxnard, CA. Also, the original vendor, SEaB Energy, has been placed under administration (the UK version of bankruptcy), so UCD selected a new vendor of similar anaerobic digestion technology with comparable specifications: Impact Bioenergy, based in WA. The CEC is will consider approval of the amendment at the January 2019 business meeting. UCD has been conducting laboratory research to evaluate how daily changes in food waste characteristics affect biogas generation and quality for a continuous AD system. A waste characterization survey is being prepared to send to various food waste providers in Ventura County. The research team has also conducted a site visit to one of Impact Bioenergy's installations in Seattle.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-019 Burney-Hat Creek Bioenergy	Technology Demonstration and Deployment	This project seeks to bring West Biofuels gasification technology, a technology funded by EPIC under an applied research and development program grant (EPC-14-024), to full commercialization. The West Biofuels gasification solution is designed to utilize forest derived biomass and is ready for scale up demonstration and deployment. To advance its commercial readiness, this project is developing and demonstrating a community-scale forest biomass facility in the Burney--Hat Creek region that is designed to address the need for increased markets for forest biomass resources. The bioenergy facility will be consistent with the requirements of the BioMAT Category 3 and obtain a power purchase agreement at a financially viable price. The plant will consume about 22,000 BDT of forest sourced feedstock per year, generate 2.88 MW of renewable energy at full rated capacity, and have a capacity factor that is greater than or equal to 75 percent.	9/13/2017	No	Generation	$5,000,000	$5,000,000	$35,558	N/A	$35,558
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-020 Demonstration of Vehicle-Grid Integration under Non-residential Scenarios	Technology Demonstration and Deployment	This agreement will demonstrate vehicle-grid integration in non-residential facilities to show the flexibility of smart charging. The team will build and validate models that incorporate usage patterns, quantify the impacts of EV charging, develop controls to manage the smart charging to minimize grid impacts and utility costs, and calculate the value streams and costs associated with realizing those value streams.	9/13/2017	No	Distribution	$2,340,000	$2,340,000	$972,883	N/A	$972,883
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-021 Mariposa Biomass Project	Technology Demonstration and Deployment	This project is designing and constructing a thermochemical biomass-to-energy conversion facility for forest wood waste that will have a capacity between 2.0-2.4 Megawatt (MW) annually and produce between 15,000 to 18,500 MWh annually of renewable, community-scale, grid-connected electricity. The project demonstrates and optimizes this forest waste bioenergy technology and assesses the performance characteristics and best practices when using wood waste from forest management as feedstock. The project is located in Mariposa, CA, often referred to as ground zero for the tree mortality disaster, and will use forest biomass obtained from a high fire hazard zone.	3/21/2018	Yes	Generation	$5,000,000	$5,000,000	$4,567	N/A	$4,567
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-022 Skid Mounted Mobile Pilot/Education Unit for Source Separated Organics Processing with Cogeneration Capabilities	Technology Demonstration and Deployment	The project's goal is to construct and demonstrate an innovative technology to pretreat organic wastes prior to anaerobic digestion at a wastewater treatment facility to enhance operational efficiencies and increase biogas production. The pretreatment technology will be constructed as skid-mounted mobile units for processing source-separated organic wastes and biosolids and will have cogeneration capabilities, thereby further increasing the energy generation from the wastewater treatment system.	11/8/2017	No	Generation	$1,589,163	$1,589,163	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-023 High Performance, Ultra-Tall, Low Cost Concrete Wind Turbine Towers Additively Manufactured On-Site	Applied Research and Development	This project aims to develop and test a reinforced concrete additive manufacturing (RCAM) technology for building low cost ultra-tall wind turbine towers onsite at a wind plant. Taller wind turbine towers capture more wind energy from faster winds aloft, but are constrained by transportation size and weight. The key goal is to develop a RCAM technology that can be used to fabricate a hybrid wind turbine tower on-site in one day at half of the cost of conventional steel towers, and reduce the levelized cost of wind generated electricity in a low wind speed site by 11%.	11/8/2017	No	Generation	$1,249,982	$1,249,982	$61,178	N/A	$61,178

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-019 Burney-Hat Creek Bioenergy	$0	$0	Hat Creek Bioenergy, LLC;	$5,000,000	50.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Fall River Resource Conservation District	Group 2: Ranked # 2
EPC-17-020 Demonstration of Vehicle-Grid Integration under Non-residential Scenarios	$0	$0	UC Santa Barbara; Google.Inc; Kisensum; ChargePoint, Inc.; Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory);	$597,593	20.3%	Grant	Pre-existing intellectual property identified in agreement EPC-17-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)	Group 4: Ranked # 3
EPC-17-021 Mariposa Biomass Project	$8,842	$0	Cortus Energy	$11,135,367	69.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Mariposa County Resource Conservation District (MCRCD)	Group 2: Ranked # 3
EPC-17-022 Skid Mounted Mobile Pilot/Education Unit for Source Separated Organics Processing with Cogeneration Capabilities	$0	$0	GHD, Inc.; Lystek International Limited; Design2Operate;	$493,075	23.7%	Grant	Pre-existing intellectual property identified in agreement EPC-17-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Lystek International Limited	Group 3: Ranked # 3
EPC-17-023 High Performance, Ultra-Tall, Low Cost Concrete Wind Turbine Towers Additively Manufactured On-Site	$164,368	$0	Jason Cotrell, dba RCAM Technologies;	$62,558	4.8%	Grant	Pre-existing intellectual property identified in agreement EPC-17-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	RCAM Technologies	Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-17-019 Burney-Hat Creek Bioenergy	N/A	N/A	None	The Burney-Hat Creek Bioenergy facility will be the first commercial deployment of an innovative gasification system that integrates a horizontally positioned rotary gasifier based off a torrefaction reactor, a thermal oxidizer and an Organic Rankine Cycle (ORC) technology in place of internal combustion engine. The technology is expected to overcome important challenges with the use of forest-sourced wood, including environmental compliance and operating challenges that are hindering large scale bioenergy projects. Under a previous R&D project, West Biofuels took a measured and strategic approach to designing modular gasification system for forest materials, which brings the selected gasification technology from research to commercial operation.	1a, 1b, 2a, 3g, 3h, 4a, 4b, 4e	The project team continued to advance a variety of project elements. All interconnection study information has been supplied to PG&E and the team is awaiting the study results. There has been substantial progress on the engineering procurement package by the equipment suppliers and the engineering team and the final deliverables are expected by the first quarter of 2019. The project team has developed a website as part of its outreach where project information articles are posted. The project team is working with local U.S. Forest Service staff to develop new fuels treatment projects that could supply feedstock to the facility.
EPC-17-020 Demonstration of Vehicle-Grid Integration under Non-residential Scenarios	N/A	N/A	Yes; Calif Based Entity	The project will develop and demonstrate advanced model-predictive control strategies that are more sophisticated than current state of the art technology by incorporating usage patterns, quantifying the impacts of EV charging while managing the smart charging and calculating the value streams/costs. This project will demonstrate how to minimize electric vehicle charging impacts on the distribution system while analyzing EV fleet capabilities under non-residential scenarios.	1h, 3f, 4b	The SLAC team collected historical data from the transformers on the distribution system at two locations on the Stanford and Google campuses to establish a baseline. The team also began collecting data from newly installed data hubs in the electric buses at Stanford, giving the team the capability of monitoring current, voltage, state of charge, and other essential parameters in real time. This data acquisition is necessary to build an accurate grid model to determine the effects of charging of vehicles. Additionally, the team developed algorithms to optimize charging under PG&E structures with time of use rates, demand charges, demand response event days, and demand response bidding.
EPC-17-021 Mariposa Biomass Project	N/A	N/A	None	The Mariposa Biomass Project has partnered with Cortus Energy to demonstrate an innovate gasification system trademarked as WoodRoll technology. The technology uses a 3-stage drying, pyrolysis and gasification process to produce a clean high BTU syngas, thus reducing costly engine maintenance costs and outages; and the gasification facility will integrate automation and remote monitoring to further reduce operating costs. The WoodRoll facility will have 16 standardized factory-tested modules that can be installed quickly and moved if necessary. The combination of high efficiency and availability combined with low operating and maintenance costs will allow the Mariposa Biomass Project to be a financially successful small-scale forest biomass demonstration facility that can be replicated in other rural areas with access to sustainable forest biomass supplies.	1a, 1b, 3g	This project was approved at the March 2018 Business Meeting. However, the project kickoff was delayed until August 14, 2018 due to an unforeseen challenge to the county-approved Conditional Use Permit. The Mariposa project team is executing its subcontract with the primary technology provider and project developer Cortus Energy. Key initial tasks related to permits, grid connection, executing subcontracts and cooperation with partners, and site locations are ongoing and currently on-schedule. Development of a "sister plant" by Cortus Energy in Sweden is also in progress; this plant is needed to validate the design and operation and, once completed, most of its component will be shipped to Mariposa.
EPC-17-022 Skid Mounted Mobile Pilot/Education Unit for Source Separated Organics Processing with Cogeneration Capabilities	N/A	N/A	Yes; Calif Based Entity	This project will combine the organic processes and anaerobic digestion that will yield greater biogas generation and utilization resulting in higher diversion of organic wastes while producing more renewable electricity than conventional digester systems. If successful, the combined technologies will provide wastewater treatment operators with greater confidence in working with organic generators and processors for accepting feedstock material suitable for co-digestion.	1a, 2a, 4a, 4e, 5b	The development of project's primary skid, which includes the test digesters, small flare and Lystek Processing reactor, is progressing; it is scheduled for completion in 2018 and delivered to the test site in January. Equipment commissioning will start in March 2019 and will be tested for about 6 to 8 months. All permitting requirements from Goleta Sanitary District and from the Santa Barbara Air Pollution Control District to facilitate equipment installation are in process with no major challenges being anticipated.
EPC-17-023 High Performance, Ultra-Tall, Low Cost Concrete Wind Turbine Towers Additively Manufactured On-Site	N/A	N/A	None	Substantial recent investments and advancements in concrete additive manufacturing technologies for buildings make this an opportune time to use the RCAM technology for constructing tall wind turbine towers in California. Concrete additive manufacturing technologies are being developed by countries around the world; however, most development has been performed on concrete printing manufacturing methods for buildings that have little or no structural reinforcement necessary for highly loaded wind turbine towers. The project team will build upon the state-of-the art technology to develop the innovative RCAM method that incorporates reinforcement in concrete printing for ultra-tall turbine towers.	2a	The team has conducted shear tests on material specimens to provide data for the finite element analysis (FEA) models necessary for fresh state properties, investigated mixes and reinforcement methods for 3D Casting, and added fiber reinforcement materials to the mix to evaluated the performance for printing the walls. The team also discussed methods of controlling shrinkage cracking with the Army Corps by spraying the wall of the structure with a coating after printing. The selected 3D printer design needs to be modified for concrete applications. The requested modifications to the vendor include a stronger extruder tube that can handle higher pumping pressure, different nozzle geometry, stronger and continuous pumping system, and addition of a degree of freedom to the printer head to facilitate rectangular print sections.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-024 Electric Access System Enhancement (EASE)	Technology Demonstration and Deployment	Distributed control capabilities will enable distributed intelligence and control capability to support fast, automated decisions and improve overall resiliency of the system. This project implements a plug and play concept to facilitate service discovery from PV and batteries both under direct control and being controlled via aggregator to streamline all interconnection types and rationalize multiple systems and processes. In addition, the project explores and demonstrates distributing the existing enterprise functions, i.e. state estimation and optimization, out on the distribution system and to the edge, where necessary and desirable to securely operate the system closer to limits.	1/17/2018	Yes	Distribution	$2,000,000	$2,000,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-025 TradePro Connect Product and Service Procurement Project	Market Facilitation	This project will develop and deploy an online platform, called TradePro Connect, that will allow customers to search for DER products of interest; find qualified contractors serving their area; request, evaluate and select bids; schedule services; and provide feedback on their experience via automated satisfaction surveys. Contractors enrolled in the platform will gain access to unprecedented new work opportunities, training, analytics on their services, and membership in an exclusive clean energy Group Purchasing Organization. The project aims to enroll a minimum of 100 contractor organizations on the platform, directing at least 30 percent of the jobs to small, disabled veteran, minority, LGBT and/or women business enterprises; as well as implement at least 50 projects during the 18-month project period.	3/21/2018	Yes	Grid Operations/Market Design	$991,110	$991,110	$388,705	N/A	$388,705
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-026 Accelerating the Adoption of EVs as DERs through Fleet Procurement	Market Facilitation	The MyFleetBuy fleet procurement system developed in this project will mitigate uncertainties for fleet managers by providing clarity on cost savings offered by EVs and smart charging, and verifying the range of viability of EVs. MyFleetBuy will leverage the sophisticated vehicle physics models underlying the LBNL-developed MyGreenCar technology, analyzing individual fleet vehicle duty cycles and translating the analysis into easy-to-understand graphics. MyFleetBuy will provide fleet managers with a low cost, highly scalable data collection and analytics system with which to compare their options when investing in new vehicles. The platform will accelerate fleet procurement of EVs by raising awareness of options while mitigating the uncertainties that limit their adoption in fleets.	3/21/2018	Yes	Grid Operations/Market Design	$1,000,000	$1,000,000	$327,282	N/A	$327,282
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-027 The Distributional Electricity Impacts of Climate Change on California's Residential Communities	Applied Research and Development	This project studies the impacts of rising temperatures on electricity demand and the related emissions of pollutants from current generation stations. On the demand side, the researchers are creating an empirically calibrated statistical model using household level data to estimate household response of electricity demand to temperature. On the supply side, the study is estimating the implications of the increased intensity and frequency of extreme heat events from climate change on peak demand and local air pollutants, GHG emissions, and costs of generating capacity in the absence of policy intervention or technology change.	3/21/2018	Yes	Generation	$200,000	$200,000	$8,332	N/A	$8,332

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EPC-17-024 Electric Access System Enhancement (EASE)	$0	$4,683,816	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Southern California Edison	N/A***
EPC-17-025 TradePro Connect Product and Service Procurement Project	$0	$0	ASWB Engineering; Cohen Ventures Inc. dba Energy Solutions; Qmerit; ProQure; Ecometes;	$994,084	50.1%	Grant	Pre-existing intellectual property identified in agreement EPC-17-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Cohen Ventures Inc. dba Energy Solutions	Group 4: Ranked # 1
EPC-17-026 Accelerating the Adoption of EVs as DERs through Fleet Procurement	$115,875	$0	Caltrans; County of Alameda; City of Oakland Bureau of Infrastructure and Operations;	$1,779,718	64.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Lawrence Berkeley National Laboratory	Group 4: Ranked # 2
EPC-17-027 The Distributional Electricity Impacts of Climate Change on California's Residential Communities	$36,240	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Berkeley	Group 4b: Ranked # 2

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EPC-17-024 Electric Access System Enhancement (EASE)	N/A	N/A	Yes; Calif Based Entity	This project will form an architecture and cooperative framework enabling a system of systems approach that streamlines the integration of distributed energy resources from planning to operations and enabling cross optimization between different participants (IOU, third-party DER owners, CAISO) to allow exchange of services and improved utilization of assets.	1d, 1g, 1h, 1i, 3f, 3h, 5b	The project was approved at the January 17, 2018 business meeting, but the agreement has not been signed by SCE yet due to concerns about the EPIC terms and conditions (TandC). As of January 4, 2019, SCE has formally accepted the EPIC TandC, revised Scope of Work, and our letter of assurances. SCE is currently working on updating the budget and schedule. The CAM has a phone call with the PI scheduled for January 31, 2019 to discuss incoming changes to the DOE schedule that will affect the CEC schedule.
EPC-17-025 TradePro Connect Product and Service Procurement Project	N/A	N/A	Yes; Small Business	By streamlining the customer's buying experience, working with the supply-chain to stock and promote best-in-class products, and ensuring proper design, installation, commissioning, operation and maintenance, the project reduces the cost and risk of DER technology procurement which increases adoption. This leads to lower energy use and GHG emissions and also facilitates compliance with SB 350's Responsible Contractor Policy.	1c, 3b	After conducting a review of the products, services, and participants that would connect with the platform, the project team has soft-launched the TradePro Connect and Manage Your Power websites. The team is currently working to add the functionality necessary to integrate the websites with existing utility, contractor, and procurement programs. Once this work is complete next year, Energy Solutions and its team will turn its focus to increasing the user base and conducting training and reporting.
EPC-17-026 Accelerating the Adoption of EVs as DERs through Fleet Procurement	N/A	N/A	Yes; Calif Based Entity	MyFleetBuy will raise fleet managers' awareness of EVs while mitigating the risks and uncertainties that inhibit their adoption of EVs. MyFleetBuy will (1) collect high-resolution data on individual fleet vehicles, including driving distances, traffic, terrain, driving style, and more, using low-cost data loggers; (2) analyze these data with sophisticated vehicle physics models; and (3) provide fleet managers with a decision-support tool to compare fuel costs of conventional, hybrid, or EVs; compare overall operating costs for all vehicles; and, calculate the difference in costs of uncontrolled vs. smart charging for EVs.	3a, 4a, 5b	Work on this agreement began in April 2018. LBNL is currently partnered with Alameda County, the City of Oakland, and CalTrans to pilot the MyFleetBuy app. The project team has presented the MyFleetBuy app to other government fleet managers, and created a demo video which was presented at several public forums, including the ACT Expo, which is a major conference in the fleet sector. Finally, the team developed and launched a website for the app: www.MyFleetBuy.com. In 2019, the team plans to: 1) launch the app for the initial fleet partners; 2) continue garnering feedback from fleet managers on consumer acceptance, making improvements, as necessary; and 3) continue partnering with additional fleet managers to help increase adoption of the app more broadly across the state.
EPC-17-027 The Distributional Electricity Impacts of Climate Change on California's Residential Communities	N/A	N/A	Yes; Calif Based Entity	This project will generate new and precise estimates of the forecasted damages to California's residential communities due to climate change. This will create a scenario in the absence of additional standards and policies (e.g., additional emissions abatement requirements) and hence create a baseline for calculating their value. These two approaches will provide the most comprehensive analysis of the impact of climate change on California's residential communities and particularly on disadvantaged communities.	2a	The kickoff meeting was held in June, 2018. Since then, the researchers have constructed the analysis dataset and begun running their statistical models for electricity generation and emissions under climate change.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-028 High Resolution Source Importance Mapping to Minimize Impacts of Waste Biomass Distributed Generation on Ozone Air Quality in Disadvantaged Communities in the San Joaquin Valley	Applied Research and Development	This project focuses on the San Joaquin Valley area and conducts a first-of-its-kind study to quantify the relative importance of individual source locations according to their ozone impacts in disadvantaged communities and non-attainment areas. The study is determining ozone polluting potential of individual project locations by application of high-resolution state-of-art chemical transport modeling coupled with other tools developed at UC Berkeley, Lawrence Berkeley National Laboratory (LBNL), and other institutions. The results are then used to develop site-specific ozone mitigation strategies.	3/21/2018	Yes	Generation	$200,000	$200,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-029 Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy	Applied Research and Development	This agreement funds a core team of scientists, students, and staff from computer science and marine biology to perform three main development tasks that will lead to open source artificial intelligence classification capabilities: 1) performing custom convolutional neural network training focused on a number of key benthic species using an iterative training process to improve the accuracy of the prediction model; 2) developing "intelligent" video/image annotation tools to augment the capabilities of existing Video Annotation Reference System from the Monterey Bay Aquarium Research Institute to streamline annotation/classification workflows; and 3) moving the annotation software, workflow, and tools to the cloud to provide widespread adoption and reiteration/customization capabilities to the broader scientific and consulting community.	3/21/2018	Yes	Generation	$199,978	$199,978	$11,852	N/A	$11,852
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-030 California Opportunities for Procurement to Accelerate Clean Energy (Cal-OP ACE)	Market Facilitation	This project will establish a new incubator program specifically geared towards bridging the gap between California clean energy companies and institutional/commercial customers that rely on formal procurement processes to purchase DER solutions and packages. The project will provide and coordinate key services, assistance, and resources needed to bridge the gap between emerging energy technology solutions and large-scale procurement processes. Cal-OP ACE will provide support to clean energy ventures navigating and competing in institutional energy procurement processes, while providing guidance to customers updating and streamlining their procurement processes for advanced DER technologies. Cal-OP ACE will be responsible for facilitating information sharing so clean energy ventures are aware of market opportunities provided by institutional customers; and institutional customers are aware of new DER technology features that can address their critical needs.	3/21/2018	Yes	Demand-side Management	$3,998,715	$3,998,715	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-031 Port of Long Beach Microgrid - Resilience for Critical Facilities	Technology Demonstration and Deployment	This project will create a microgrid at the Port's critical response facility, the Joint Command and Control Center (JCCC). Key features include photovoltaic energy production, stationary battery energy storage, mobile battery energy storage, and a microgrid controller. Both batteries will provide grid services, such as demand response and peak shaving, during regular operation of the utility grid. During wide-spread outages or emergencies, the microgrid will support the Joint Command and Control Center, which coordinates response to emergencies. The mobile battery will act to extend the microgrid as a zero-emission generator that can be deployed where needed, such as stormwater pump stations and refrigerated container yards.	3/21/2018	Yes	Distribution	$5,000,000	$5,000,000	$0	N/A	$0

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-028 High Resolution Source Importance Mapping to Minimize Impacts of Waste Biomass Distributed Generation on Ozone Air Quality in Disadvantaged Communities in the San Joaquin Valley	$89,052	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Lawrence Berkeley National Laboratory	Group 4a: Ranked # 1
EPC-17-029 Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy	$29,057	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Cal Poly Corporation	Group 4b: Ranked # 1
EPC-17-030 California Opportunities for Procurement to Accelerate Clean Energy (Cal-OP ACE)	$128,875	$0	Energy Solutions; Lawrence Berkeley National Laboratory; Prospect Silicon Valley; TerraVerde; Ecomedes; California State University - Office of the Chancellor;	$1,244,450	23.7%	Grant	Pre-existing intellectual property identified in agreement EPC-17-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Prospect Silicon Valley	Group 3: Ranked # 1
EPC-17-031 Port of Long Beach Microgrid - Resilience for Critical Facilities	$0	$0	Electric Power Research Institute, Inc.; National Renewable Energy Laboratory; Advanced Power and Energy Program (APEP) - University of California, Irvine; Schneider Electric USA Inc.; City of Long Beach, Harbor Department (Port of Long Beach); Advanced Transportation and Renewables Energy	$2,120,000	29.8%	Grant	Pre-existing intellectual property identified in agreement EPC-17-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	City of Long Beach, Harbor Department (Port of Long Beach)	Group 1: Ranked # 2

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EPC-17-028 High Resolution Source Importance Mapping to Minimize Impacts of Waste Biomass Distributed Generation on Ozone Air Quality in Disadvantaged Communities in the San Joaquin Valley	N/A	N/A	Yes; Calif Based Entity	This study maps both local and upwind emission sources that contribute to ozone air pollution in disadvantaged communities (DAC) and uses the source importance mapping to develop site-specific ozone mitigation strategies.	2a, 4b	The project was executed in late November 2018. The project manager is working with the research team to schedule the kick-off meeting.
EPC-17-029 Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy	N/A	N/A	Yes; Calif Based Entity	This project provides advanced tools to scientists to facilitate the efficient collection of higher quality data that will provide regulators, decision makers, and the public with greater scientific certainty regarding the impact of marine renewable energy on California's marine ecological resources. Reducing the regulatory uncertainty of marine renewable energy production will provide decision makers with better information about impacts of offshore renewables as California seeks to achieve its Renewable Portfolio Standards goals (currently 60% by 2030) and the 100% zero-carbon electricity goal established in SB 100.	2a, 4f	The kickoff meeting was held in June, 2018. The project team is nearing completion of development of the video annotation software and has begun annotating the pilot underwater video from the Monterrey Bay Aquarium Research Institute. Once these tasks are complete, they will begin developing the machine learning portion of the project. The first TAC meeting provided many useful suggestions for enhancements to the tool and for potential extensions to other applications. Computer science students are gaining real-world experience coding the software, while marine biology students are learning to identify species in the underwater video.
EPC-17-030 California Opportunities for Procurement to Accelerate Clean Energy (Cal-OP ACE)	N/A	N/A	Yes; Calif Based Entity	The need for connecting DERs to Integrated Demand Side Management (IDSM) strategies has been well-established in the following state policy contexts: 1) California energy code (Title 24) requirements for building controls and demand response (DR) capabilities; 2) AB 802 requirements for utilities to shift to Normalized Metered Energy Consumption (NMEC) to inform more rigorous utility pay for performance efficiency programs; 3) SB 350 doubling energy efficiency targets and rolling out a responsible contractor policy to ensure proper installation and commissioning of DERs; and 4) AB 793 energy management technology requirements.	1c, 1f, 2a, 3e	The project started on August 21, 2018. Since then, Prospect Silicon Valley developed a survey for institutional buyers and DER companies to assess buyers' awareness of existing procurement programs, opportunities for improvement, and requirements for institutional procurement. Moving forward, the project work will focus on conducting surveys and developing the Cal-OP ACE website.
EPC-17-031 Port of Long Beach Microgrid - Resilience for Critical Facilities	N/A	N/A	Yes; Calif Based Entity	The project has several innovations, including the ability to allow for direct DC transfer of energy from the PV system to the battery, significantly improving the efficiency of the stored energy, and testing charge and discharge strategies for the mobile battery to support load reduction during normal operations and providing support power to various distributed critical loads in an emergency.	1b, 1c, 1h, 4a, 5b	The project kick-off was held in June, 2018. The project team is in the early stages of identifying energy systems integration options and opportunities for expanding the use of renewable generation, while finalizing subcontracts.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-032 Miramar Microgrid - Flight Line Resilience through Landfill Gas and Energy Storage	Technology Demonstration and Deployment	This project will install a microgrid at Marine Corps Air Station Miramar. It will incorporate five distributed energy resources: bio gas generators, solar PV, battery energy storage, and electric vehicles. When operational, the microgrid will help maintain critical flight line facilities during grid outages and facilitate higher renewable generation from landfill gas (LFG) generators.	3/21/2018	Yes	Demand-side Management	$5,000,000	$5,000,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-033 Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience	Applied Research and Development	This project builds on the Cal-Adapt platform to provide enhanced tools, data services, and visualizations that leverage the existing web infrastructure and features to improve usability to energy sector stakeholders. Research team will collaborate closely with the Energy Commission and energy stakeholders including IOUs and the California Independent System Operator (CAISO) to build on Cal-Adapt, developing enhanced targeted visualizations and tools that allow for improved decision support that leverages projections of parameters associated with climate-related risk. Priority tools will address sea level rise and wildfire. These new tools are being designed in close coordination with stakeholders, as the requirements of each organization necessitates tools that are specific to their application needs. Targeted visualization tools depict climate-related risks from a variety of stressors on electricity infrastructure, enabling improved planning for future reliability.	3/21/2018	Yes	Grid Operations/Market Design	$900,000	$900,000	$206,392	N/A	$206,392
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-034 California Energy Product Evaluation Hub	Market Facilitation	This project will develop the California Energy Product Evaluation (Cal-EPE) Hub to conduct and disseminate evaluations of advanced DER products relevant to large commercial and institutional customers through a web-based buyer's guide. To accomplish this, the recipient will: (1) determine Cal-EPE Hub user (i.e. large commercial and institutional customers) needs; (2) develop a list of product categories to evaluate based on user needs; (3) develop evaluation guidelines and methodologies; (4) acquire (through purchase or donation) and evaluate products from product categories; and (5) develop a web-based Buyer's Guide, which will contain the results of product evaluations and related information and documentation.	3/21/2018	Yes	Demand-side Management	$10,993,646	$10,993,646	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-035 Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley	Applied Research and Development	This project develops a holistic community action plan to achieve climate benefits and air quality improvements through energy efficiency measures, electrification, and distributed energy resources in the residential building and light-duty and medium-duty transportation sectors in the city of Fresno. Field survey and validation testing provide inputs on appropriate implementation strategies and selection of systems and technologies to overcome barriers associated with site characteristics and user responses. The researchers are monitoring energy use and air quality in typical households within the disadvantaged communities for accurate and realistic inputs in the analysis for large scale implementation of similar programs.	4/11/2018	Yes	Distribution	$1,100,000	$1,100,000	$454,691	N/A	$454,691

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-032 Miramar Microgrid - Flight Line Resilience through Landfill Gas and Energy Storage	$425,962	$0	Marine Corps Air Station Miramar;	$6,002,320	54.6%	Grant	Pre-existing intellectual property identified in agreement EPC-17-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	The Regents of the University of California, San Diego	Group 1: Ranked # 4
EPC-17-033 Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience	$172,916	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Berkeley	Group 3: Ranked # 1
EPC-17-034 California Energy Product Evaluation Hub	$916,282	$0	Center for the Built Environment - UC Berkeley; Western Cooling Efficiency Center - UC Davis; Sheet Metal Workers 104 and Bay Area Industry Training Fund; Collaborative for High Performance Schools; Lawrence Berkeley National Laboratory; Local Government Commission; Cohen Ventures Inc. dba Energy Solutions;	$2,347,629	17.6%	Grant	Pre-existing intellectual property identified in agreement EPC-17-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Western Cooling Efficiency Center - UC Davis	Group 2: Ranked # 1
EPC-17-035 Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley	$401,103	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Lawrence Berkeley National Laboratory	Group 2b: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-17-032 Miramar Microgrid - Flight Line Resilience through Landfill Gas and Energy Storage	N/A	N/A	Yes; Calif Based Entity	This Agreement will lead to technological advancement and breakthroughs to overcome barriers to achieving California's statutory energy goals by demonstrating a replicable and scalable solution to advance energy security and resilience through the use of a microgrid. This project will address critical challenges associated with reacting to the instantaneous loss of power from the bio gas generators by using microgrid controlled distributed energy resources such as solar PV and energy storage to mitigate any electrical interruptions while providing a reliable and resilient energy source. The technical approach and business case will be relevant to landfills with landfill gas generation, wastewater treatment plants with biogas generation, as well as hospitals, ports, and military bases.	2a, 3h, 4b, 5a	Minor delays in getting subcontractors in place but work is now proceeding to make up time.
EPC-17-033 Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience	N/A	N/A	Yes; Calif Based Entity	This project will lead to advancements and breakthroughs that help achieve the state's statutory energy goals by providing needed actionable information on climate change consequences on electricity generation and distribution to energy sector stakeholders. California's energy system is facing, and will continue to contend with, a changing climate. Substantial changes in the climate are projected to occur within a timeframe that overlaps with the time horizons of a variety of electricity system planning decisions, such as siting of power generation facilities and transmission lines. Regionally downscaled climate projections with high spatial resolution are valuable resources to better plan electricity and energy infrastructure developments, adaptations, and future siting.	3a, 5c	The research team has established a Technical Advisory Committee that includes representatives from IOUs, a meteorologist from NOAA, CAISO, and other state agencies with whom it is important to coordinate on energy sector adaptation efforts. Newsletters have been issued (June 2018 and November 2018) to showcase recent developments, including new visualizations showing frequency of heat waves, longest stretch of consecutive extreme heat days (or warm nights) by year, extended drought scenarios, hourly sea level rise, and more. Additionally, several new datasets have been incorporated, including solar radiation and hourly sea level rise projections at key coastal sites. Early feedback from the TAC indicates that the hourly sea level rise data have already been useful in PG&E planning, specifically in siting transmission towers in the vicinity of the San Francisco Bay.
EPC-17-034 California Energy Product Evaluation Hub	N/A	N/A	Yes; Calif Based Entity	The California Energy Product Evaluation (Cal-EPE) Hub will increase the adoption of advanced DER technology products in the marketplace by disseminating reliable and independent product evaluations to large commercial and institutional customers, through a web-based buyer's guide, which will help these customers more confidently select the DER technology they require with their procurement process.	1c, 1f, 1h, 2a, 3b, 3e, 3h, 4a	Overall, the project is on schedule. The recipient has already completed the following in preparation of evaluating products: - Developed the interview guide for interviewing potential Cal-EPE Hub users about their specific needs regarding advanced DER products. - Compiled a list of target customers (large commercial and institutional customers) to interview and conduct surveys with. - Compiled a list of eligible product categories that will be considered for evaluation. In early 2019, the recipient will focus on the following: - Conducting interviews, developing the survey guide, and conducting surveys with target customers. - Recording the findings of the interviews and surveys within the Hub User Needs Report to help direct product category selection. - Performing activities to determine which product categories to evaluate, and what their priority will be in the evaluation schedule.
EPC-17-035 Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley	N/A	N/A	Yes; Calif Based Entity	This project provides state-of-the-art information and analyses on the impacts of prioritized and integrated energy efficiency, electrification, and distributed energy resources, and battery electric vehicles, in the Fresno area on climate benefits and air quality improvements.	1f, 2a, 4b	The project kick-off meeting was conducted in November 2018. The research team is working on obtaining energy and building data from different sources such as the utility company and the city of Fresno.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-038 Camp Parks Army Microgrid – A Blueprint for Nested, Modular Design	Technology Demonstration and Deployment	The Parks Reserve Forces Training Area (PRFTA) microgrid project will produce a permanent, modular, nested design that maximizes renewables and is inherently secure, expandable, economically viable and efficient. The project will deliver a blueprint for incorporating multiple distributed energy resources (DER); a vendor-neutral microgrid control system; and a resilient nodal building block approach that supports grid-within-grid nesting. The project will also develop engineering guidelines and an easy-to-adapt "how-to" case tool for accelerated adoption and commercialization.	3/21/2018	Yes	Demand-side Management	$5,000,000	$5,000,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-039 DER-VET A Distributed Energy Resource Value Estimation Tool	Applied Research and Development	This project will develop the Distributed Energy Resource Value Estimation Tool (DER-VET), a publicly-available, open-source, microgrid valuation and optimization software tool to aide in the design of microgrid and distributed energy resource deployments.	5/9/2018	Yes	Distribution	$2,000,000	$2,000,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-040** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	Applied Research and Development	This project will develop and demonstrate standardized energy efficiency retrofit packages, specifically geared towards low-income multifamily housing market, and that can be scaled to drive down costs. As part of the agreement, the recipient will develop a business model for these packages to overcome financing challenges.	6/13/2018	Yes	Demand-side Management	$2,401,436	$2,401,436	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-040** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	Technology Demonstration and Deployment	This project will develop and demonstrate standardized energy efficiency retrofit packages, specifically geared towards low-income multifamily housing market, and that can be scaled to drive down costs. As part of the agreement, the recipient will develop a business model for these packages to overcome financing challenges.	6/13/2018	Yes	Demand-side Management	$4,802,872	$4,802,872	$0	N/A	$0

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EPC-17-038 Camp Parks Army Microgrid – A Blueprint for Nested, Modular Design	$817,221	$0	Customized Energy Solutions; Ultrasolar Technology; U.S. Army;	$11,410,900	69.5%	Grant	Pre-existing intellectual property identified in agreement EPC-17-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 3
EPC-17-039 DER-VET A Distributed Energy Resource Value Estimation Tool	$0	$0	Electric Power Research Institute, Inc.; XENDEE;	$568,110	22.1%	Grant	Pre-existing intellectual property identified in agreement EPC-17-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1
EPC-17-040** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	$1,307,443	$0	Association for Energy Affordability; Rocky Mountain Institute; Stone Energy Associates; City of San Francisco Department of Environment;	$6,705,308	48.2%	Grant	Pre-existing intellectual property identified in agreement EPC-17-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Prospect Silicon Valley	Group 3: Ranked # 1
EPC-17-040** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	$0	$0	Association for Energy Affordability; Rocky Mountain Institute; Stone Energy Associates; City of San Francisco Department of Environment;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Prospect Silicon Valley	Group 3: Ranked # 1

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EPC-17-038 Camp Parks Army Microgrid – A Blueprint for Nested, Modular Design	N/A	N/A	Yes; Calif Based Entity	This project will demonstrate how a nested set of smaller microgrids within an overall base microgrid can be designed and operated to provide resilience on the base, while substantially reducing energy use and the need for multiple backup diesel generators. This approach can be transferrable to other military bases or similar commercial or academic campuses or local communities to improve resilience.	1h, 2a, 3h, 5a	The agreement was fully executed on December 7, 2018. The kick-off meeting will take place in early 2019.
EPC-17-039 DER-VET A Distributed Energy Resource Value Estimation Tool	N/A	N/A	None	This Agreement will lead to technological advancement and breakthroughs by developing a new tool for microgrid development by utilities and developers that will evaluate how the DER and microgrid systems can be optimized for sizing, owner benefits, and use as flexible grid resources.	1b, 1c, 1f, 1h, 5b, 5f	This project was launched in May 2018. The team developed the draft model specification and the software development plan and will be vetting the approach to a representative user community prior to full development.
EPC-17-040** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	N/A	N/A	Yes; Calif Based Entity	Significant improvements in retrofit production speed and cost reductions are critical to realizing a mass-scale existing building energy efficiency improvements. Even when pairing the significant grant funding from the State's Low-Income Weatherization Program for Multifamily Properties, it is rare that those retrofit projects alone can achieve ZNE. The key to bringing costs down and construction speeds up is to simultaneously address the technical and business model barriers that still exist in the market. Some of the innovative approaches the project team is considering include: modularized, pre-fabricated, pre-insulated building enclosures, packaged multi-function heat pumps for heating, cooling, energy recovery ventilation, advanced heat pump water heaters, and behavior modification technologies and strategies.	1f, 2a, 3a, 3b, 3f	This project had a kickoff meeting in October 2018. In December 2018 a stop work order was issued for team organization reasons. The project will move forward once these issues are resolved.
EPC-17-040** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	N/A	N/A	Yes; Calif Based Entity	Significant improvements in retrofit production speed and cost reductions are critical to realizing a mass-scale existing building energy efficiency improvements. Even when pairing the significant grant funding from the State's Low-Income Weatherization Program for Multifamily Properties, it is rare that those retrofit projects alone can achieve ZNE. The key to bringing costs down and construction speeds up is to simultaneously address the technical and business model barriers that still exist in the market. Some of the innovative approaches the project team is considering include: modularized, pre-fabricated, pre-insulated building enclosures, packaged multi-function heat pumps for heating, cooling, energy recovery ventilation, advanced heat pump water heaters, and behavior modification technologies and strategies.	1f, 2a, 3a, 3b, 3f	This project had a kickoff meeting in October 2018. In December 2018 a stop work order was issued for team organization reasons. The project will move forward once these issues are resolved.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-041** Lead Locally	Applied Research and Development	In the applied research phase of the project, the team is evaluating promising emerging efficiency technologies to determine whether these technologies can meet cost-effectiveness, feasibility, and customer acceptance thresholds that would allow them to be included in the existing building retrofit strategies developed under this project. In the technology deployment phase, the team is taking a three-pronged approach to increase existing building retrofits. The first will be development of an "Energy Marketplace" where consumers can directly procure technologies appropriate for their buildings. The second will be to combine financing options with mid-stream rebates to greatly expand the pool of customers who can take advantage of the Energy Marketplace. This will target those who have little to no upfront capital and are the most difficult to reach. And third, training will be offered to contractors, realtors, and building officials with the goal of greatly increasing customer knowledge, decreasing code violations, and increasing penetration of energy efficiency measures outside the framework of utility programs.	4/11/2018	Yes	Demand-side Management	$3,271,532	$3,271,532	$11,891	N/A	$11,891
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-041** Lead Locally	Technology Demonstration and Deployment	In the applied research phase of the project, the team is evaluating promising emerging efficiency technologies to determine whether these technologies can meet cost-effectiveness, feasibility, and customer acceptance thresholds that would allow them to be included in the existing building retrofit strategies developed under this project. In the technology deployment phase, the team is taking a three-pronged approach to increase existing building retrofits. The first will be development of an "Energy Marketplace" where consumers can directly procure technologies appropriate for their buildings. The second will be to combine financing options with mid-stream rebates to greatly expand the pool of customers who can take advantage of the Energy Marketplace. This will target those who have little to no upfront capital and are the most difficult to reach. And third, training will be offered to contractors, realtors, and building officials with the goal of greatly increasing customer knowledge, decreasing code violations, and increasing penetration of energy efficiency measures outside the framework of utility programs.	4/11/2018	Yes	Demand-side Management	$6,543,064	$6,543,064	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-042 Camptonville Biomass-to-Energy Project	Technology Demonstration and Deployment	The project will demonstrate an innovative 3 MW biomass power plant located in Camptonville, California that will: Produce a replicable power plant design that can help reduce costs for future plants, and accelerate adoption of comparable capacity biomass plants at other California locations Demonstrate a robust direct combustion technology that has the flexibility to utilize diverse biomass feedstock available throughout California Validate significant reductions in NOx, CO, and VOC emissions, and Reduce water consumption required for biomass power generation Increase availability of renewable electricity and grid reliability while reducing emissions and wildfire threats.	10/3/2018	Yes	Generation	$4,999,830	$4,999,830	$0	N/A	$0

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EPC-17-041** Lead Locally	$4,687,705	$0	Sonoma Clean Power Authority ; TBD - Design Build Contractor;	$3,335,500	25.4%	Grant	Pre-existing intellectual property identified in agreement EPC-17-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Sonoma Clean Power Authority	Group 2: Ranked # 1
EPC-17-041** Lead Locally	$0	$0	Sonoma Clean Power Authority ; TBD - Design Build Contractor;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Sonoma Clean Power Authority	Group 2: Ranked # 1
EPC-17-042 Camptonville Biomass-to-Energy Project	$0	$0	Phoenix Energy;	$13,030,225	72.3%	Grant	Pre-existing intellectual property identified in agreement EPC-17-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	51 out of 81 bidders	ICF Incorporated, L.L.C.	Ranked # 4

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EPC-17-041** Lead Locally	N/A	N/A	Yes; Calif Based Entity	The project could increase market penetration for existing building retrofits and result in deeper savings per site using the existing program funding that SCP and the investor-owned utilities will allocate in future years. The project anticipates providing a full range of options for customers--from whole building integrated retrofits to partial retrofits and traditional equipment upgrades, depending on the customer's interest, budget, and need. The high level estimated net present value of the project benefits is over $60M in 2030. Additional benefits could be realized if fuel-switching strategies that are being evaluated as part of the applied research phase of the project meet cost-effectiveness, feasibility, and customer acceptance criteria and can be included in the Energy Marketplace.	1f, 1h	The project is on schedule. The Evaluation Framework and Research Plans have been completed and over 200 Sonoma Clean Power customers have applied to have their homes/small businesses included in the research phase of the project. Suitable test sites will be selected according to the research framework and installations will begin in Q1 2019. The "Energy Marketplace" storefront site has been established and renovation plans are under development. The facility is on track to open, on schedule by Q3 2019.
EPC-17-041** Lead Locally	N/A	N/A	Yes; Calif Based Entity	The project could increase market penetration for existing building retrofits and result in deeper savings per site using the existing program funding that SCP and the investor-owned utilities will allocate in future years. The project anticipates providing a full range of options for customers--from whole building integrated retrofits to partial retrofits and traditional equipment upgrades, depending on the customer's interest, budget, and need. The high level estimated net present value of the project benefits is over $60M in 2030. Additional benefits could be realized if fuel-switching strategies that are being evaluated as part of the applied research phase of the project meet cost-effectiveness, feasibility, and customer acceptance criteria and can be included in the Energy Marketplace.	1f, 1h	The project is on schedule. The Evaluation Framework and Research Plans have been completed and over 200 Sonoma Clean Power customers have applied to have their homes/small businesses included in the research phase of the project. Suitable test sites will be selected according to the research framework and installations will begin in Q1 2019. The "Energy Marketplace" storefront site has been established and renovation plans are under development. The facility is on track to open, on schedule by Q3 2019.
EPC-17-042 Camptonville Biomass-to-Energy Project	N/A	N/A	Yes; Calif Based Entity	The plant's key technologies have been successfully used as individual components, but they have not been demonstrated as an integrated system at the relatively small scale (3 MW) intended for this project. The innovation for this project is to design and build a 3 MW forest biomass-to-electricity power plant using an advanced emissions control and low water use condenser. The facility is estimated to consume 30,000 bone dry tons of woody biomass annually, which will be derived from dead and diseased trees and forest byproducts harvested from public and private forested lands near Camptonville, California.	1a, 1b, 1c, 2a	The project was approved at a Business Meeting on October 3, 2018. However, the agreement is not executed and is being placed on hold due to a recent project site issue. The current project site is pulling out and thus the project is in need of finding an alternative site. Finding and readying an alternative site will tremendously impact the schedule; it may require a new CEQA study and interconnection requirements from CAISO and PG&E.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-043 GLOW: A User-friendly Interface for GridLAB-D	Applied Research and Development	This project is developing GridLAB-D Open Workspace (GLOW), an intuitive interface for GridLAB-D that will provide a user-friendly environment for researchers, planners, developers, and regulators involved in advanced electric grid technology modeling. The interface will simplify data input and simulations, enable visualization of complex information, and be scalable for big data simulations. GLOW will be a freely available and widely supported open-source tool based on existing GridLAB-D technology.	5/9/2018	Yes	Distribution	$2,999,699	$2,999,699	$689,172	N/A	$689,172
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-044** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	Applied Research and Development	This project is developing a web-based marketplace platform for connecting customers with energy service providers, technologies, and lenders; installing retrofits at a variety of commercial customer sites in southern California, including schools, community centers, and a refrigerated warehouse; and developing a scalable, programmatic model for commercial customer retrofits. The projects will also evaluate pay-for-performance concepts including financing components to offset customer costs, insurance markets to reduce perceived risk for lenders, and a sales-as-a-service marketplace where efficiency products and services are connected with sales professionals.	6/13/2018	Yes	Demand-side Management	$2,399,772	$2,399,772	$90,067	N/A	$90,067
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-044** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	Technology Demonstration and Deployment	This project is developing a web-based marketplace platform for connecting customers with energy service providers, technologies, and lenders; installing retrofits at a variety of commercial customer sites in southern California, including schools, community centers, and a refrigerated warehouse; and developing a scalable, programmatic model for commercial customer retrofits. The projects will also evaluate pay-for-performance concepts including financing components to offset customer costs, insurance markets to reduce perceived risk for lenders, and a sales-as-a-service marketplace where efficiency products and services are connected with sales professionals.	6/13/2018	Yes	Demand-side Management	$4,799,543	$4,799,543	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-045 Oak View Microgrid: Using Microgrid Technologies to Simultaneously Improve Quality of Life and Electric Grid Operations	Applied Research and Development	This project develops multiple urban energy scenarios (UES) in which multiple types of energy efficiency, electrification, and microgrid technologies are considered. The design approach will use integrated methods that simultaneously consider the various technology and retrofit options, while also verifying that the proposed technology mixes accomplish the goals of improving air quality and grid operations. The work will result in the proposal of a microgrid design ready for implementation in Oak View, extensible UES that can be used throughout the State, and an extensible and robust design methodology that can be used throughout the state for economic and environmentally sensitive microgrid development.	4/11/2018	Yes	Grid Operations/Market Design	$1,099,760	$1,099,760	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-046 HiPAS GridLAB-D: A High-Performance Agent-based Simulation using GridLAB-D	Applied Research and Development	The HiPAS GridLAB-D project will increase the performance of the open-source version of GridLAB-D and improve the broad accessibility of high-performance power grid modeling capabilities to the community of smart grid modelers and distribution simulation users in California. HiPAS includes methods that parallelize many of the iterative methods used in simulations. HiPAS is intended for both desktop multi-core processors and cloud platforms. It will enable GridLAB-D users to more efficiently analyze multiple scenarios with improved resolution by reducing the computational costs associated with analysis.	5/9/2018	Yes	Grid Operations/Market Design	$3,068,781	$3,068,781	$1,248,211	N/A	$1,248,211

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-043 GLOW: A User-friendly Interface for GridLAB-D	$0	$0	Hitachi America LTD; National Grid;	$1,255,060	29.5%	Grant	Pre-existing intellectual property identified in agreement EPC-17-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Hitachi America LTD	Group 4: Ranked # 1
EPC-17-044** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	$2,139,730	$0	InTech Energy, Inc.;	$2,600,274	26.5%	Grant	Pre-existing intellectual property identified in agreement EPC-17-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	InTech Energy, Inc.	Group 1: Ranked # 1
EPC-17-044** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	$0	$0	InTech Energy, Inc.;	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	InTech Energy, Inc.	Group 1: Ranked # 1
EPC-17-045 Oak View Microgrid: Using Microgrid Technologies to Simultaneously Improve Quality of Life and Electric Grid Operations	$157,594	$0	County of Orange/City of Huntington Beach; National Renewable Energy Laboratory (NREL); Altura Associates, Inc.; ComUNIDAD;	$367,804	25.1%	Grant	Pre-existing intellectual property identified in agreement EPC-17-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Irvine	Group 2a: Ranked # 2
EPC-17-046 HiPAS GridLAB-D: A High-Performance Agent-based Simulation using GridLAB-D	$0	$0	National Grid;	$300,000	8.9%	Grant	Pre-existing intellectual property identified in agreement EPC-17-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	SLAC National Accelerator Laboratory	Group 3: Ranked # 1

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-17-043 GLOW: A User-friendly Interface for GridLAB-D	N/A	N/A	None	The technical advancement of the project is the development of an intuitive and widely available user interface for GridLAB-D, a software simulation tool for advanced distribution system modeling developed by the U.S. Department of Energy.	3b, 3c, 5b	The project was kicked off in August, 2018. The team has started interviewing California users of GridLAB-D to develop use cases. This user input will guide the development of the screens and user interface for GLOW.
EPC-17-044** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	N/A	N/A	Yes; Calif Based Entity	This project will accelerate the adoption of market-driven, pay-for-performance retrofits at commercial customer sites. It does so by creating a scalable, programmatic model for undertaking a retrofit. This project will also maximize market potential by using Sales-as-a-Service marketplace energy efficiency technology where customers, products and supporting services can connect with industry professionals. Through this marketplace, the value of energy efficiency will be standardized and transparent, lowering cost and time to implement these technologies. The combination of these methods, along with new energy efficiency technologies in the demonstration sites, will showcase how cost-effective, energy-efficient solutions can be provided in a timely fashion.	1e, 1f, 1h	This project began in September 2018. The recipient is developing a mock-up for the Sales-as-a-Service platform tool.
EPC-17-044** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	N/A	N/A	Yes; Calif Based Entity	This project will accelerate the adoption of market-driven, pay-for-performance retrofits at commercial customer sites. It does so by creating a scalable, programmatic model for undertaking a retrofit. This project will also maximize market potential by using Sales-as-a-Service marketplace energy efficiency technology where customers, products and supporting services can connect with industry professionals. Through this marketplace, the value of energy efficiency will be standardized and transparent, lowering cost and time to implement these technologies. The combination of these methods, along with new energy efficiency technologies in the demonstration sites, will showcase how cost-effective, energy-efficient solutions can be provided in a timely fashion.	1e, 1f, 1h	This project began in September 2018. The recipient is developing a mock-up for the Sales-as-a-Service platform tool.
EPC-17-045 Oak View Microgrid: Using Microgrid Technologies to Simultaneously Improve Quality of Life and Electric Grid Operations	N/A	N/A	Yes; Calif Based Entity	This project will advance the integration of emerging and proven green energy technologies, with various end-uses in the Oak View community helping to facilitate the implementation of SB 535 and AB1550 that require maximizing benefits from low-carbon technologies to disadvantaged communities. For the first time, this study will assess ways to reduce particulate matter, nitrogen oxides and other indoor and outdoor air pollutants associated with appliances used in homes and electricity generated and served to the subject community. The research team will use big data to develop decarbonization pathways for the energy system in a targeted community that will include increased energy efficiency improvements within existing residential buildings, renewable energy generation and energy storage technologies, vehicle electrification, and electrification of natural gas appliances.	1f, 1h, 2a, 4a, 4b	The project was kicked off on November 26, 2018. In early 2019, the research team will collect "big data" for electrical and natural gas consumption capturing information on the current state of the built environment (building types, construction materials, design, vintage, functionality, disrepair, etc.) in the Oak View community. The data will be used to determine energy efficiency retrofit measures and suitable microgrid technologies for the community.
EPC-17-046 HiPAS GridLAB-D: A High-Performance Agent-based Simulation using GridLAB-D	N/A	N/A	Yes; Calif Based Entity	The project will achieve technology advancement and usability breakthroughs in the following performance areas: 1) Granular object-level parallelization of computations; 2) Large-scale parametric job control; 3) Sensitivity analysis; and 4) Monte Carlo analysis. These will improve the accessibility and applicability of GridLAB-D to users in California's utilities, government agencies, and researchers who are concerned with system policy, planning, operation and oversight in the presence of growing customer-based demand response and renewable energy resources.	1a, 1b, 3a, 5b	The project was recently begun. The team has begun working with Pacific Northwest National Laboratory, which developed GridLAB-D and is helping to refine the computational code that will allow the software to run more efficiently, and thus reduce calculation time and expense.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-047 OpenFIDO: An Open-source Framework for Integrated Data Operations	Applied Research and Development	This project will develop OpenFIDO an open source tool to transfer models and data between various programs that are part of the suite of tools used in by utilities, distributed energy resource (DER) engineers and regulators in California. The tool is an integration framework to quickly move data from one application to another as part of their engineering, planning, and review activities.	5/9/2018	Yes	Distribution	$1,000,000	$1,000,000	$287,976	N/A	$287,976
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-048 Engaging Communities in the Design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley	Applied Research and Development	Through the analysis of "big data" comprising remotely sensed images (e.g. agriculture lands, road networks, built environment) and Geographic Information System (GIS) layers (e.g. energy consumption, distribution networks, new build construction, reserve areas and planning documents), the project team is developing an analysis that isolates specific dense urban areas with both high potential for retrofits and energy system synergies while meeting the needs of disadvantaged communities. Through the identification of critical "Urban-Agriculture Interface Zones" using a GIS-based hot spot analysis across the Southern San Joaquin Valley, the project identifies and engages with communities to develop Sustainable Energy and Localized Futures (SELF). Contact with SELF communities is through community-based organizations. This project identifies opportunities in the SELF communities for efficiency and energy system improvements based on analysis of energy optimization tools such as the Solar, Wind, Investment in Technology, Hydropower (SWITCH) model. An optimization model is being developed for these densely populated zones to design "SELF- SWITCH" systems (SELF-SWITCH model).	4/11/2018	Yes	Grid Operations/Market Design	$1,100,000	$1,100,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-049 Port of San Diego Microgrid – Resiliency in Terminal Operations	Technology Demonstration and Deployment	The District proposes to develop a new, permanent, renewable microgrid at the Tenth Avenue Marine Terminal that can be replicated at other seaport terminals and distribution facilities throughout California, the U.S., and internationally. The project will incorporate solar photovoltaic renewable generation, battery energy storage, energy efficiency improvements, and a centralized microgrid controller to allow key elements of the terminal to remain operational when islanded from the electrical grid for a minimum of 12 hours. The proposed microgrid will test the integration of four distributed energy resources.	5/9/2018	Yes	Distribution	$4,985,272	$4,985,272	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-050 Using Big Data to Holistically Assess Benefits from Building Energy System Transition Pathways in Disadvantaged Communities	Applied Research and Development	This research project supports a holistic urban energy planning for the Avocado Heights community that considers, simultaneously, urban renewables, indoor and outdoor air quality, deep energy efficiency options, retrofit of homes and buildings, electrification, and environmental justice concerns.	7/11/2018	Yes	Distribution	$1,098,662	$1,098,662	$0	N/A	$0

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EPC-17-047 OpenFIDO: An Open-source Framework for Integrated Data Operations	$367,282	$0	National Grid;	$30,000	2.9%	Grant	Pre-existing intellectual property identified in agreement EPC-17-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	SLAC National Accelerator Laboratory	Group 2: Ranked # 1
EPC-17-048 Engaging Communities in the Design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley	$164,853	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Berkeley	Group 2b: Ranked # 2
EPC-17-049 Port of San Diego Microgrid – Resiliency in Terminal Operations	$0	$0	The Regents of the University of California, San Diego; San Diego Unified Port District (Port of San Diego);	$4,629,936	48.2%	Grant	Pre-existing intellectual property identified in agreement EPC-17-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	San Diego Unified Port District (Port of San Diego)	Group 1: Ranked # 5
EPC-17-050 Using Big Data to Holistically Assess Benefits from Building Energy System Transition Pathways in Disadvantaged Communities	$167,847	$0	Regents of the University of California, Los Angeles;	$54,740	4.7%	Grant	Pre-existing intellectual property identified in agreement EPC-17-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Los Angeles	Group 2a: Ranked # 1

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EPC-17-047 OpenFIDO: An Open-source Framework for Integrated Data Operations	N/A	N/A	Yes; Calif Based Entity	Current modelling tools do not support the exchange of data to other programs. This is not sufficient when many different tools are used to analyze the many multi-disciplinary problems energy system researchers, analysts and regulators must address. OpenFIDO proposes to use an open multi-standard approach to data exchange called polyglot representation. This approach allows data to be exchanged so that data models of commercial buildings, retail tariffs, and distribution networks can be reliably exchanged between the various distribution system analysis tools that are currently used.	1b, 1c, 5a, 5b	The project has just started. The project team is conducting research of end users to identify the most used planning tools in California. Preparation is underway to hold a requirements identification workshop to identify the various planning tools and the priority needs for data interchange.
EPC-17-048 Engaging Communities in the Design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley	N/A	N/A	Yes; Calif Based Entity	This research is advancing the state of the art by developing a new model that can explore the cost and feasibility of generation, transmission, and storage options for the future electricity system in a sub-regional environment. The model identifies cost-effective investment decisions for meeting electricity demand, taking into account the existing grid as well as projections of future technological developments, renewable energy potential, fuel costs, and public policy. Integrating this model with updated GIS and geographically relevant data and algorithms for a sub-regional development will assist California's energy system planners.	3a	The project kick-off meeting was held in March 2019, and the team is recruiting Technical Advisory Committee members, acquiring datasets, and engaging community stakeholders.
EPC-17-049 Port of San Diego Microgrid – Resiliency in Terminal Operations	N/A	N/A	Yes; Calif Based Entity	The project will develop a solar-powered, resilient microgrid that will allow key elements of the terminal to remain operational for 12 hours or longer when islanded from the grid.	1b, 1c, 1h, 4a, 5b	The project kick-off was held in June, 2018. The Port is in the early stages of identifying options for renewable energy, energy efficiency and energy storage to support microgrid design.
EPC-17-050 Using Big Data to Holistically Assess Benefits from Building Energy System Transition Pathways in Disadvantaged Communities	N/A	N/A	Yes; Calif Based Entity	Energy planning is usually conducted in a piecemeal fashion. For example, looking at opportunities for energy efficiency programs for the natural gas system or just looking at the transportation sector. This project, and other sister research projects, are taking a very different approach using a holistic approach for urban energy planning with the final goal of identifying economically attractive options for deep GHG reductions and improved environmental conditions.	4a, 4b	The research team has assembled a multi-disciplinary research team that has expertise in all required areas (e.g., public health, energy engineering, and public outreach). The research is in close contact with community-based representatives. This will allow the research team to elicit community perspectives during the execution of the project to determine what the community defines success.

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2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-051 LEED: A Lightwave Energy-Efficient Datacenter	Applied Research and Development	The goal of this federal cost share grant, the Lightwave Energy-Efficiency Datacenter (LEED) program, is to at least double the current energy efficiency of a datacenter. This dramatic improvement is realized by increasing the energy utilization of each server by means of a novel lightwave network. The LEED network can substantially increase the network bandwidth which leads to a corresponding improvement in the server energy utilization. This improvement can be realized at a cost comparable to a state-of-the-art datacenter network based on conventional electrical switching technologies.	5/9/2018	Yes	Demand-side Management	$475,000	$475,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-052 Urban Microgrids for Grid Resiliency and Disaster Readiness	Technology Demonstration and Deployment	The project will deploy microgrids at five disadvantaged community sites in Stockton, Fontana and Richmond. These sites include two fire stations, a police station, a 911 call center, and two emergency shelters such as Fontana City Hall and Richmond King Elementary School. The project will also develop a system capable of operating these five microgrids remotely. Each microgrid will be able to operate independently to reduce facility electric costs and to island in the event of an emergency to keep critical operation running.	5/9/2018	Yes	Distribution	$4,995,498	$4,995,498	$119,958	N/A	$119,958
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-053 Santa Rosa Junior College Urban Microgrid Project	Technology Demonstration and Deployment	Santa Rosa Junior College (SRJC) is developing a microgrid demonstration project on campus. This project will integrate three types of distributed energy resource (DER) elements: solar photovoltaic (PV) generation, energy storage, and load reduction devices and load control systems, all managed by a single microgrid controller. The goals of this project are to meet 40% of the campus electricity requirement with emissions-free PV solar power, to reduce the campus peak load, to optimize energy use, to provide support services to the surrounding grid, and to create a highly resilient power system benefitting the campus and the community. The primary objectives of the project are to demonstrate the environmental, economic, and resiliency benefits of a highly flexible campus microgrid. Operational objectives encompass demonstration of power flow, load control, and energy storage in a large multi-building campus, operating at appropriate scale and in actual operating conditions.	6/13/2018	Yes	Demand-side Management	$4,999,005	$4,999,005	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-054 Rialto Resilient Clean Power Microgrid	Technology Demonstration and Deployment	The project will install an advanced microgrid system that will include 2.0 MWh of battery electric storage, a 2.0 MW biogas-fueled cogeneration unit, and a microgrid control system at the Rialto Bioenergy Facility (RBF). The microgrid will manage the distributed energy resources to meet power demand loads at the RBF, while minimizing grid draw and enhancing renewable electricity export. Additionally, the microgrid will enable the operations to continue indefinitely in the event of a grid outage using availability of feed stock (i.e., food waste and biosolids).	7/11/2018	Yes	Grid Operations/Market Design	$5,000,000	$5,000,000	$0	N/A	$0

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-051 LEED: A Lightwave Energy-Efficient Datacenter	$78,440	$4,418,524	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-17-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	The Regents of the University of California, San Diego	N/A***
EPC-17-052 Urban Microgrids for Grid Resiliency and Disaster Readiness	$0	$0	Electric Power Research Institute, Inc.; InTech Energy, Inc.; TRC Energy Services;	$3,281,992	39.6%	Grant	Pre-existing intellectual property identified in agreement EPC-17-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Gridscape Solutions, Inc.	Group 2: Ranked # 1
EPC-17-053 Santa Rosa Junior College Urban Microgrid Project	$0	$0	SunPower Corporation, Systems; Sonoma County Junior College District/ Santa Rosa Junior College;	$8,689,759	63.5%	Grant	Pre-existing intellectual property identified in agreement EPC-17-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Sonoma County Junior College District/ Santa Rosa Junior College	Group 3: Ranked # 3
EPC-17-054 Rialto Resilient Clean Power Microgrid	$0	$0	GHD, Inc.; The Grant Farm, Inc.; Rialto Bioenergy Facility LLC; Trinity Consultants;	$6,515,000	56.6%	Grant	Pre-existing intellectual property identified in agreement EPC-17-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Rialto Bioenergy Facility LLC	Group 2: Ranked # 2

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-17-051 LEED: A Lightwave Energy-Efficient Datacenter	N/A	N/A	Yes; Calif Based Entity	This project will lead technological advancement in lightwave technology for datacenters. It could double the efficiency of these datacenters by increasing the response speed and reducing energy input.	1c, 1f, 2a	The recipient tested the first design for the optical switch and began development of synchronization for the pinwheel switch and has also begun characterization of the devices for the interconnections. Recipient is on schedule.
EPC-17-052 Urban Microgrids for Grid Resiliency and Disaster Readiness	N/A	N/A	Yes; Calif Based Entity, Minority Owned	This project will lead to technological advancement and breakthroughs by developing and demonstrating the ability to remotely operate multiple microgrids, which can be useful for keeping all critical functions operational in the event of a grid outage, reducing utility costs, and minimizing the reliance on diesel backup generators.	1a, 3h, 4a, 5a, 5b	GridScape started the project in August and has begun developing the preliminary designs of the microgrids.
EPC-17-053 Santa Rosa Junior College Urban Microgrid Project	N/A	N/A	Yes; Calif Based Entity	This project will result in advancements in the deployment of a microgrid, including the use of storage technologies, adaptive load management, and the monetization of microgrid assets while providing community support facilities in times of need. This project will also demonstrate coordination of multiple large energy storage devices with different dynamic capabilities. By demonstrating a local approach to stabilizing utility grid frequency, the microgrid will be transformed from a source of load transients to a point of stabilization reaching far beyond the point of interconnection.	1c, 1g, 1h, 2a, 3f, 3h, 4a, 4b, 5a, 5b, 5d	Staff participated in a kickoff meeting at the Santa Rosa Junior College in Santa Rosa on October 26, 2018. On the same date, staff also participated in a public event hosted by the Local Government Sustainable Energy Coalition titled, "Disasters and Energy Resilience: Santa Rosa Junior College Microgrid Tour." This tour and discussion included a review of the current Santa Rosa Junior College microgrid design, completed microgrid infrastructure to date, and plans for future infrastructure integration.
EPC-17-054 Rialto Resilient Clean Power Microgrid	N/A	N/A	Yes; Calif Based Entity	This project will demonstrate the business case for a microgrid that can improve operations of a food and biowaste treatment facility and wastewater treatment facility located in a disadvantage community. The microgrid will use a microgrid controller to optimize the use of a biogas cogeneration system, fueled by available feedstock, and working with energy storage to enable the facility to continue operations during a grid outage. This project will demonstrate the microgrid's ability to provide benefits to the residents of the disadvantaged community by providing opportunities to participate in demand response activities, providing cleaner air quality, and increasing grid reliability and resiliency. The business case could be applicable to the 156 critical waste water treatment plants across California.	1b, 1e, 1f, 1h, 4a, 4b, 4d, 4e, 5b, 5f	Minor delays in getting subcontracts in place but work is now proceeding to make up time.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-055 Redwood Coast Airport Renewable Energy Microgrid	Technology Demonstration and Deployment	This project is a community scale renewable energy microgrid located at the Redwood Coast Humboldt County Airport. It will demonstrate the first multi-customer, front-of-the-meter microgrid with renewable energy generation owned by a CCA (Redwood Coast Energy Authority or RCEA) and the microgrid circuit owned by an IOU (PG&E). This microgrid will allow the CCA to participate in the CAISO wholesale electricity market and provide low carbon resilience to a commercial airport and U.S. Coast Guard Air Station, which are critical emergency facilities in Humboldt County.	6/13/2018	Yes	Distribution	$5,000,000	$5,000,000	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-001 Port Hueneme Navy Server Farm Building Microgrid	Technology Demonstration and Deployment	This project will demonstrate a standardized, high-penetration distributed energy resource (DER) microgrid to support a data center at the Naval Surface Warfare Center - Port Hueneme Division near Oxnard, CA. The data obtained on capital cost, operating cost, performance and lessons learned will support commercial deployment for both military and non-military applications.	9/21/2018	Yes	Grid Operations/Market Design	$4,998,345	$4,998,345	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-002 California Test Bed Initiative	Market Facilitation	This project will develop and implement a voucher program to provide clean energy companies access to testing facilities to test and/or certify prototypes of pre-commercial distributed energy resource technologies, and help them refine their prototype to meet customer specifications. This project will start with an initial network of testing facilities that includes 29 University of California facilities from all ten campuses and two National Laboratory facilities. The project intends to grow this network throughout the duration of the project. This network of testing facilities will connect testing facilities throughout California, which would otherwise be disconnected, in order to serve clean energy companies more efficiently and effectively throughout all of California.	12/10/2018	Yes	Demand-side Management	$10,999,701	$10,999,701	$0	N/A	$0
			Active, Completed and Terminated in 2018					**$638,045,742**	**$638,045,742**	**$229,483,211**	**$0**	**$229,483,211**
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-004 Systems Integration of Containerized Molten Salt Thermal Energy Storage in Novel Cascade Layout	Applied Research and Development	The project aimed to build, validate, thermally cycle, and pilot test a modular 75 kW, 6 hour (500 kWh) molten salt thermal energy storage (TES) system, using standard shipping containers and commercially available tanks and insulation. The project leverages a novel cascaded tank arrangement and high-volume manufacturing and factory assembly, to significantly reduce the installed cost of TES for concentrating solar power (CSP).	12/10/2014	No	Generation	$1,500,000	$1,500,000	$377,870	N/A	$377,870
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-007 Improving Short-Term Wind Power Forecasting through Measurements and Modeling of the Tehachapi Wind Resource Area	Applied Research and Development	This project comprises coordinated atmospheric field measurements and computational modeling improvements to improve the accuracy of prediction of short-term wind ramps (i.e. large, rapid changes in wind power production). The Tehachapi Pass Wind Resource Area is the focus of the project. Since the area features complex terrain and meteorology, the findings can be readily adapted and applied to many other regions.	12/10/2014	No	Generation	$1,000,000	$1,000,000	$993,172	N/A	$993,172

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-17-055 Redwood Coast Airport Renewable Energy Microgrid	$407,963	$0	Humboldt State University Sponsored Programs Foundation; Redwood Coast Energy Authority;	$6,322,728	55.8%	Grant	Pre-existing intellectual property identified in agreement EPC-17-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Humboldt State University Sponsored Programs Foundation	Group 3: Ranked # 2
EPC-18-001 Port Hueneme Navy Server Farm Building Microgrid	$848,609	$0	Distributed Utility Associates; Electric Power Research Institute, Inc.; Schweitzer Engineering Laboratories, Inc.;	$3,502,754	41.2%	Grant	Pre-existing intellectual property identified in agreement EPC-18-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 6
EPC-18-002 California Test Bed Initiative	$610,684	$0	California Clean Energy Fund dba CalCEF Ventures; University of California, Office of the President;	$887,053	7.5%	Grant	Pre-existing intellectual property identified in agreement EPC-18-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	California Clean Energy Fund dba CalCEF Ventures	Group 1: Ranked # 1
	$112,641,069	**$72,173,891**		**$336,901,550**							
EPC-14-004 Systems Integration of Containerized Molten Salt Thermal Energy Storage in Novel Cascade Layout	$283,080	$0	Halotechnics;	$19,038	1.3%	Grant	Pre-existing intellectual property identified in agreement EPC-14-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Halotechnics	Group 1: Ranked # 1
EPC-14-007 Improving Short-Term Wind Power Forecasting through Measurements and Modeling of the Tehachapi Wind Resource Area	$247,542	$0	Department of Mechanical and Aerospace Engineering - UC Davis;	$90,325	8.3%	Grant	Pre-existing intellectual property identified in agreement EPC-14-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	University of California - Davis	Group 2: Ranked # 4

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-17-055 Redwood Coast Airport Renewable Energy Microgrid	N/A	N/A	Yes; Calif Based Entity	In order to manage increased DERs, California needs sophisticated DER management systems and strategies, and microgrids can play an important role in this regard. This project, with its innovative microgrid control architecture and DC-coupled, community scale solar PV/battery energy storage system designed for both end-use customer support and wholesale market participation, will lead to significant technological advancements and breakthroughs. Furthermore, PG&E will develop engineering standards, testing protocols, and equipment specifications for multi-customer, front-of-the-meter microgrids within their distribution system and RCEA as the CCA administrator will collaborate with PG&E to create experimental tariffs and agreements for development and operation of the microgrid. These tariffs and agreement will become important examples to other IOUs and CCAs.	1a, 1b, 1e, 1g, 1i, 2a	The agreement was executed on August 8, 2018, and the project kick-off meeting was held at the project site on August 10th. The Schatz Energy Research Center (SERC) executed subcontracts and developed a MOU between key project partners. In addition, SERC worked with the Redwood Coast Energy Authority (RCEA) to finalize a $6 million USDA loan package and with the Humboldt County Aviation Department to secure project approval from the FAA. The project team also worked to define the microgrid system architecture and to start procurement negotiations for key components, including the battery energy storage system, solar PV system, and microgrid controls. SERC engaged with PG&E on distributed generator interconnection and worked with RCEA and PG&E on a set of microgrid operational responsibilities to support the first multi-customer microgrid in PG&E's service territory.
EPC-18-001 Port Hueneme Navy Server Farm Building Microgrid	N/A	N/A	None	This project will develop new approaches to developing microgrids that can ensure stable power to sensitive components, such as in data centers. The team will demonstrate a standardized microgrid, analyze and define the savings and market barriers, and provide new, valuable performance data that will be used to develop a viable market for future deployments.	1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a	The project kick-off was held in December. The project team began engineering analysis for the development of the microgrid system design and coordinated these activities with the Naval Base Ventura County host site contact. The team will finalize the adaptive microgrid system architecture in the second quarter of 2019 and start procurement negotiations for key components.
EPC-18-002 California Test Bed Initiative	N/A	N/A	None	CalTestBed will accelerate new, clean, energy-efficient technologies to market and, as a result, reduce ratepayer costs. By early engagement of target customer groups in the refinement of product specifications and the evaluation of commercial viability, CalTestBed will accelerate the rate of development and commercialization of technologies that improve California's air, water and energy profile and drive economic investment, business creation and jobs.	2a, 3a, 3b, 3e	This agreement was approved at the December 2018 Business Meeting. In 2019, the recipient will focus on developing and finalizing all materials, plans, and processes necessary to launch the CalTestBed voucher program. This will include creating materials and processes to solicit applications from clean energy companies for inclusion in the CalTestBed voucher program.
EPC-14-004 Systems Integration of Containerized Molten Salt Thermal Energy Storage in Novel Cascade Layout	N/A	N/A	None	The Halotechnics thermal storage system sought to improve system design and modularity and reduce the cost of molten salt energy storage by 25% by reducing the required storage volume. However, researchers found that the innovative storage technology would have to be very large to cost competitive with battery storage and, therefore, would not effectively reduce the cost of small CSP plants to make them competitive in the market.	1i, 2a, 3b	The project was approved at the December 10, 2014 Energy Commission Business Meeting and the project work was started in January 2015. The process design and the mechanical design of all major components were completed, along with specified control system requirements which included the use of three tanks, the minimum number prescribed to evaluate the operation and viability of a multiple tank system. Halotechnics terminated the project after 10 months prior to the procurement of any hardware due to insufficient commercial traction from customers in the concentrated solar power industry.
EPC-14-007 Improving Short-Term Wind Power Forecasting through Measurements and Modeling of the Tehachapi Wind Resource Area	N/A	N/A	None	Improvements to accuracy of short-term (3-15 hours) and very short-term (0-3 hours) wind ramp forecasting would reduce generating reserves scheduled by grid operators, with corresponding decreases in grid operating costs and greenhouse gas emissions, and, simultaneously, increased grid reliability.	1c, 3b, 5c	The project team has completed the measuring program that included sodar, ceilometer, radiometer, radar wind profiler, and radio acoustic sounder measurements scattered over six sites and completed a forecast sensitivity study of wind ramping behavior based on suite of physics-based predictive models versus observed sodar data, including obtaining results for a sensitivity study of observed bias of mean absolute error of 0-15 hour energy forecast for Tehachapi wind resource area.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-019 Validated and Transparent Energy Storage Valuation and Optimization Tool	Applied Research and Development	This project developed, tested, and validated a publicly available computer model for the CPUC's energy storage use cases that determines the most optimal energy storage systems. This software model successfully assesses costs and benefits and guides energy storage projects with respect to location, size, and type. The software is publicly released as a cloud-hosted tool.	3/11/2015	No	Grid Operations/Market Design	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-026 Examining the Heterogeneity of Energy Efficiency Adoption and Savings Across Socio-Economic and Ethnic Groups Using a Large Scale Quasi-Experiment	Market Facilitation	This project conducted a quasi-experimental, econometric study of energy efficiency adoption and energy savings with a focus on differences between social, cultural, and socio-economic groups. The study applied modern economic methods to Southern California Edison's Quality Installation Program, including regression-discontinuity and propensity score matching. The large data sets and rigorous methods resulted in estimates to improve demand forecasts, energy efficiency program design, and future energy studies concerning social, cultural, and socioeconomic groups.	4/8/2015	No	Demand-side Management	$360,632	$360,632	$360,584	N/A	$360,584
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-027 High Temperature Hybrid Compressed Air Energy Storage (HTH-CAES)	Applied Research and Development	This project designed a low-cost 74kW pilot High Temperature Hybrid Compressed Air Energy Storage (HTH-CAES) system that can efficiently store grid-level energy and release that energy when it is needed to meet peak demand, particularly for ancillary services and load following use-cases. This project documented and reported on the design, anticipated performance and lessons learned of the HTH-CAES system to increase knowledge and understanding of how these storage systems perform and the barriers to siting and operations.	4/8/2015	No	Distribution	$1,621,628	$1,621,628	$632,754	N/A	$632,754
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-034 Interra Reciprocating Reactor for Low-Cost & Carbon Negative Bioenergy	Applied Research and Development	The purpose of this was to install and demonstrate an advanced modular bioenergy technology. The pilot-scale demonstration was intended to help determine if the performance of the technology, along with biomass co-product value creation enhancement strategy, was sufficiently powerful to overcome the affordability burdens that currently block the feasibility of distributed generation bioenergy projects in California.	4/8/2015	No	Generation	$2,000,000	$2,000,000	$1,353,332	N/A	$1,353,332
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-039 Cultural Factors in the Energy Use Patterns of Multifamily Tenants	Market Facilitation	This project examined the cultural and demographic factors that correlate with multifamily tenants' electric energy use patterns, before and after energy efficiency upgrades, and tenant engagement activities. Using multilevel tenant surveys and interval meter data analytics this study investigated the who, what, and why variations in multifamily energy use patterns. The large data sets will help to improve demand forecasts and energy efficiency program design by providing lessons learned and guidance for how social, cultural, and socioeconomic groups use energy differently in multifamily settings.	4/8/2015	No	Demand-side Management	$379,019	$379,019	$368,358	N/A	$368,358

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-019 Validated and Transparent Energy Storage Valuation and Optimization Tool	$482,416	$0	Electric Power Research Institute, Inc.;	$901,944	47.4%	Grant	Pre-existing intellectual property identified in agreement EPC-14-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1
EPC-14-026 Examining the Heterogeneity of Energy Efficiency Adoption and Savings Across Socio-Economic and Ethnic Groups Using a Large Scale Quasi-Experiment	$65,406	$0	The Regents of the University of California, Berkeley;	$150,784	29.5%	Grant	Pre-existing intellectual property identified in agreement EPC-14-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	The Regents of the University of California, Berkeley	Ranked # 1
EPC-14-027 High Temperature Hybrid Compressed Air Energy Storage (HTH-CAES)	$206,222	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-14-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Regents of the University of California, Los Angeles	Group 2: Ranked # 3
EPC-14-034 Interra Reciprocating Reactor for Low-Cost & Carbon Negative Bioenergy	$264,400	$0	Interra Energy, Inc.;	$4,627,400	69.8%	Grant	Pre-existing intellectual property identified in agreement EPC-14-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Interra Energy, Inc.	Group 1: Ranked # 2
EPC-14-039 Cultural Factors in the Energy Use Patterns of Multifamily Tenants	$107,714	$0	Pacific Gas and Electric Company;	$100,000	20.9%	Grant	Pre-existing intellectual property identified in agreement EPC-14-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	TRC Engineers, Inc.	Ranked # 2

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EPC-14-019 Validated and Transparent Energy Storage Valuation and Optimization Tool	N/A	N/A	Yes; Calif Based Entity	This agreement developed a "first of its kind" publically available tool that determines the value of energy storage with respect to location, size, and type.	1c, 1i, 2a, 4a, 5b	The project successfully ended on December 30, 2016, and the final report was published. The final report can be seen at: http://www.energy.ca.gov/2017publications/CEC-500-2017-016/CEC-500-2017-016.pdf After project was completed, ongoing outreach activities continue. For example, the tool was presented to NYSERDA for testing, and a meeting was held between the CEC and CPUC staff to present the tool's capabilities and its potential adoption for future procurement decisions. Additionally, the California Energy Commission held a public workshop for the purpose of training and obtaining feedback for future refinement of the tool.
EPC-14-026 Examining the Heterogeneity of Energy Efficiency Adoption and Savings Across Socio-Economic and Ethnic Groups Using a Large Scale Quasi-Experiment	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) set energy efficiency targets for 2030 and allowed for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project team recommended designing future residential energy efficiency programs that target low-income customers in hot climate zones, and account for time-of-use rates in California. Key findings that led to these recommendations were that hot climate zone was a huge factor in getting customers to participate in this HVAC program, low-income households experienced greater savings because existing household appliances were usually less efficient and more noticeably improved, and that energy savings, due to participating in the program, were the greatest between the hours of 3-9 pm in the months of August and September due to peak demand rates.	2a, 5c	The project team submitted its Final Report in March 2017, and had its final meeting in July 2017. Project findings suggest that: climate is the strongest variable for customer participation in t SCE's Quality Installation Program (participants in hot areas saved ~1100 kWh annually, compared to 300 kWh in warm areas and 0 in mild areas), savings were higher for lower income homes than for high income homes but lower income homes participated less frequently, the most significant hours for achieving energy savings were shown to be 3-9 pm, and that future energy efficiency programs should be focused on increasing participation of low-income homes in hot areas.
EPC-14-027 High Temperature Hybrid Compressed Air Energy Storage (HTH-CAES)	N/A	N/A	Yes; Calif Based Entity	Compressed air energy storage may be a viable solution for long-term and large-scale storage applications. HTH-CAES potentially has lower capital and maintenance cost and less geographic restrictions than other storage technologies. In the HTH-CAES technology, compressors are used to convert inexpensive off-peak electric power into compressed air and thermal reservoirs.	1c, 1i, 2a, 4a, 5b	The design of a 74kW HTH-CAES system was completed and is ready for a future demonstration. The final report includes a description of the piping and instrumentation, the mechanical/thermal design of the energy storage, and the completed 3D layout of the plant. All major components for construction were purchased, several patents were developed and journal articles were published. The final report is being prepared for publishing on the Commission website.
EPC-14-034 Interra Reciprocating Reactor for Low-Cost & Carbon Negative Bioenergy	N/A	N/A	Yes; Calif Based Entity	If successful, this project could help stabilize the grid, improve service reliability, and reduce the risk of forest fire. Advanced bioenergy systems that produce useful co-products can also reduce the cost of renewable energy procurement and mitigate the GHG impacts of energy generation.	1c, 4a, 4b	The project faced serious technological challenges and Interra Energy was unable to demonstrate progress towards meeting the project requirements. The Energy Commission determined that results from the bioenergy system are not satisfactory and the interim reports are technically deficient. As a result, the Energy Commission staff terminated the agreement at the August 2017 Business Meeting.
EPC-14-039 Cultural Factors in the Energy Use Patterns of Multifamily Tenants	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project provides program developers information on how social, cultural, and behavior aspects of multi-family building tenants impact participation in utility efficiency programs. The findings in the survey will help design utility efficiency programs to better engage customers in multifamily units to increase participation and achieve greater energy savings.	2a, 5c	This project was completed in December 2017. The project surveyed energy use in multi-family units in the Bay Area and the Central Valley. The project found that the differences between load profiles are also correlated with demographic and cultural factors such as race/ethnicity of the occupants as well as the amount of plug loads they use. These are second order effects though to the weather-dependent energy use such as use of cooling energy in the hot Central Valley versus relatively mild coastal areas. The multivariate analysis shows that no single demographic or cultural factor (nor interactions with others) by themselves explain the differences more than or as much as the effects of location and climate. The initial finding of the TRC survey were presented at the BECC Conference on October 17, 2017 in Sacramento, CA.

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2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-072 Building a Healthier and More Robust Future: 2050 Low Carbon Energy Scenarios for California	Applied Research and Development	The researchers developed long-term energy scenarios for California that comply with GHG emission targets and goals. The scenarios provide new insights about technology options and by when some of this options should be implemented.	5/13/2015	No	Generation	$700,000	$700,000	$700,000	N/A	$700,000
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-083 College of San Mateo Internet of Energy	Technology Demonstration and Deployment	This project was initiated to demonstrate an integrated solar PV, energy storage, and advanced power electronics within a single module to significantly increase overall efficiencies by minimizing conversion losses. The demonstration was to include the integration of a 250 kW pre-commercial high-yield PV system from Flex, a 500 kWh stationary battery energy storage system, and advanced HVAC system and controls, with an advanced energy management system that uses the Internet of Energy concept to optimize performance of distributed energy resources and the local grid.	6/10/2015	No	Generation	$2,999,601	$2,999,601	$402,626	N/A	$402,626
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-034 Emerging Energy Public Health Research Roadmap	Applied Research and Development	This research develops a research needs assessment that focuses on the known and potential public health impacts of emerging energy systems. The needs assessment is based on consultation with experts in emerging energy systems and occupational and environmental health (OEH) and with stakeholder representatives from labor, business, government, and community-based organizations.	4/13/2016	No	Generation	$151,000	$151,000	$150,998	N/A	$150,998
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-049 Electricity Pumped Storage Systems Using Underground Reservoirs: A Feasibility Study for the Antelope Valley Water Storage System	Applied Research and Development	The project conducts a feasibility study that determines the value of energy storage and associated grid support benefits provided by Peak Hour Pumped Storage and Aquifer Pumped Hydro applications at an existing water bank. The feasibility study also identifies critical parameters for success for both technologies and identifies other water banking sites in the state where these technologies are likely to be successful.	5/17/2016	No	Generation	$197,300	$197,300	$136,796	N/A	$136,796
			Completed and Terminated Before 2018					**$11,909,180**	**$11,909,180**	**$6,476,490**	**$0**	**$6,476,490**
			Total Active, Completed and Terminated as of December 31, 2018					**$649,954,922**	**$649,954,922**	**$235,959,700**	**$0**	**$235,959,700**

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-14-072 Building a Healthier and More Robust Future: 2050 Low Carbon Energy Scenarios for California	$236,701	$0	University of California, Berkeley;	$65,000	8.5%	Grant	Pre-existing intellectual property identified in agreement EPC-14-072 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Lawrence Berkeley National Laboratory	Group 5: Ranked # 1
EPC-14-083 College of San Mateo Internet of Energy	$411,350	$0	Growing Energy Labs, Inc.; San Mateo County Community College District;	$1,235,000	29.2%	Grant	Pre-existing intellectual property identified in agreement EPC-14-083 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	Prospect Silicon Valley	Group 2: Ranked # 4
EPC-15-034 Emerging Energy Public Health Research Roadmap	$0	$0	None	$0	0.0%	Grant	Pre-existing intellectual property identified in agreement EPC-15-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Public Health Institute	Group 3: Ranked # 1
EPC-15-049 Electricity Pumped Storage Systems Using Underground Reservoirs: A Feasibility Study for the Antelope Valley Water Storage System	$15,276	$0	CIM Group;	$199,353	50.3%	Grant	Pre-existing intellectual property identified in agreement EPC-15-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Antelope Valley Water Storage, LLC	Group 11: Ranked # 1
	$2,320,107	**$0**		**$7,388,844**							
	$114,961,176	**$72,173,891**		**$344,290,394**							

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-14-072 Building a Healthier and More Robust Future: 2050 Low Carbon Energy Scenarios for California	N/A	N/A	Yes; Calif Based Entity	The researchers developed a stochastic version of their electricity model to explore issues such as path dependences. The preliminary final results indicates, among other things, that achieving the 2030 GHG target will be extremely difficult with a high percentage of natural gas appliances still in operation. However, this target can be met if California starts electrifying energy services and decarbonize power generation at a fast rate. The electrification of the industrial sector will be difficult even though the electrification technical potential is high. This is mostly due to the costs associated with electrification of the industrial sector. The use of PVs in disadvantages communities may not substantially improve local air quality or public health.	2a, 3f, 3h, 4a	LBNL and UC Berkeley have developed several long-term energy scenarios for California. The team attempted to harmonize assumptions with E3 and UC Irvine. These two entities performed similar analyses (long-term energy scenarios) than LBNL/UCB, but using different tools. The LBNL/UCB team is modeling the entire Western Electric Coordinating Council (WECC) to investigate if a changing of geographical coverage can affect the long-term energy scenarios. They also used a more granular model of the electricity system both in space and time with, for example, several load centers in the WECC instead of representing California as one block.
EPC-14-083 College of San Mateo Internet of Energy	N/A	N/A	Yes; Calif Based Entity	If successful, this project was projected to result in a 10% reduction in utility demand charges for the College of San Mateo campus in addition to saving another 8% in energy charges from peak demand reduction and efficient energy management measures. In addition, the PV and energy storage system was to be designed in a modular fashion by housing the Energy Storage System and Power Conversion System in a standard 20-foot container enclosure that was being produced to dramatically reduce balance of system costs.	1a, 1b, 1e, 1f, 1h, 1i, 2a, 3a, 3e, 4a	The College of San Mateo released an RFP for construction and installation of the project in February 2017 and selected Opterra in April 2017, but the project experienced several delays related to equipment sourcing and legal requirements. In late July 2017, the College of San Mateo decided to withdraw from the project, because the perceived risks were too great, and they did not believe that the full scope of the agreement could be completed within the agreement term. As the College of San Mateo was providing the demonstration site for the project as well as the majority of the match funds, Energy Commission staff and PSV decided to mutually terminate the project. The Energy Commission issued a Stop Work Order to PSV on August 7, 2017, and the Commission formally terminated the agreement at the October 11, 2017, business meeting.
EPC-15-034 Emerging Energy Public Health Research Roadmap	N/A	N/A	Yes; Calif Based Entity	This report establishes a public health research roadmap aimed at anticipating and preventing potential unintended health impacts of emerging electricity generating, storing, and distributing systems (EES). Research recommendations were prioritized and presented in this roadmap.	4b, 5d	In 2017, the research team held 22 meetings with 34 experts throughout the energy, life cycle assessment, health, labor, and environmental justice field for total for over 30 hours. The team also created a growing database of peer-reviewed and grey literature. As of December 2017, the database houses 165 documents on Emerging Electricity-Generating Systems and related health and equity topics. Workshops were conducted in spring and summer of 2017 to obtain inputs. The research roadmap was published in fall 2017.
EPC-15-049 Electricity Pumped Storage Systems Using Underground Reservoirs: A Feasibility Study for the Antelope Valley Water Storage System	N/A	N/A	Yes; Calif Based Entity	This project conducts feasibility analyses of Aquifer Pumped Hydro and Peak Hour Pumped Storage for energy storage purposes, hydropower generation, and demand response potential if implemented at a groundwater bank. Potential barriers are identified and economic analysis conducted to identify types of implementation with the highest value. The project is developing a set of tools other water banks can use to conduct similar assessments. Based on preliminary review, these tools could be very useful for all water banks in California.	1e, 3f	The research team conducted technical feasibility analysis and preliminary field testing of two pumped storage systems: Peak Hour Pumped Storage (PHPS) and Aquifer Pumped Hydro (APH) storage at Willow Spring Water Bank. Hydropower generation and demand response potential of groundwater banking projects were assessed. The results show low efficiency and revealed water quality issues as a potential barrier for implementation for the APH system. The demand response during a dry hydrologic year has the highest value based on analysis. The project also created tools for other groundwater banks in California to conduct similar analysis. The project was completed as planned in September 2017 and the final report is published.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
			Terminated Projects with no Funds Spent - Not Included in the Project Count or Amount. ****									
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-011 Isothermal Compressed Air Energy Storage with Solar and Load Forecasting Integration	Applied Research and Development	LightSail Energy, along with its partner, the University of California San Diego (UCSD), will design build, operate, monitor, and analyze an I-CAES system on the Eliot Field PV station owned by UCSD. The energy storage system will be a pilot unit for testing the capabilities and performance potential of I-CAES for load following and ancillary services, as well as renewable integration. The project will also gather data needed to reduce the cost of I-CAES, increase its efficiency, and support its incorporation into the California electric grid. The installed energy storage system will be capable of charging from both the installed PV on site and the electric grid (operated by SDG&E) and will be capable of 200kW of discharging power and will store up 800kWh of energy.	12/9/2015	No	Distribution	$1,200,276	$1,200,276	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-017 Utilizing Waste Heat to Increase Efficiency of Isothermal Compressed Air Energy Storage in a Smart Microgrid Environment	Applied Research and Development	LightSail Energy will install and pilot test a 200kW I-CAES system at the UCI campus in Irvine California. The storage unit will be operated in conjunction with UCI's 1,000kW solar PV array and 300kW advanced natural gas turbine, all interconnected through an advanced "smart" microgrid. The I-CAES system will use waste heat from the gas turbine to increase round-trip efficiency. This is possible because I-CAES uses large water tanks as thermal storage, capturing and storing the heat of compression for use when the system is expanding air and producing electricity. The waste heat from the gas turbine will be captured and stored in the I-CAES thermal storage tanks and later converted into electricity. This project will provide the state's first real-world data on the operation and performance of an isothermal compressed air energy storage system and its ability to utilize waste heat for increased efficiency.	1/13/2016	No	Grid Operations/Market Design	$1,085,125	$1,085,125	$0	N/A	$0
2012-14 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-052 ZipPower San Leandro	Market Facilitation	This project will develop and pilot a platform that optimizes distributed energy resource planning by integrating and automating all the data required to target optimal sites across city areas, and streamline pre-approval of the permitting and interconnection at those sites. The project will also use aggregated customer financing as an option to design, finance, deploy, scale, and replicate Advanced Energy Communities.	5/17/2016	No	Demand-side Management	$1,495,338	$1,495,338	$0	N/A	$0
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-060 Adaptive Chargers for Delivery Customers Demonstrating California Advances in Charging	Technology Demonstration and Deployment	Motiv Power Systems is developing both a smart charger solution and a bi-directional charger solution to enable vehicle-grid integration (VGI) with electric fleet vehicles. This technology is being demonstrated with AmeriPride Services delivery trucks in Fresno, Bakersfield, Merced, and Stockton. Motiv is developing both a software-only smart charger solution as well as a bi-directional on-board charger solution for vehicles that can be easily purchased as an option for installation on existing vehicles. This solution will fit within a scalable and modular powertrain already used in a variety of vehicle applications, thus allowing VGI solutions to fit within a variety of emerging markets and be supplied to vehicle builders from a variety of delivery trucks, work trucks, shuttle buses, and school buses. This allows VGI to fit both within goods movement and freight plans as well as clean transit and zero-emission bus plans.	5/10/2017	No	Demand-side Management	$4,529,956	$4,529,956	$0	N/A	$0

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-15-011 Isothermal Compressed Air Energy Storage with Solar and Load Forecasting Integration	$102,846	$0	LightSail Energy	$779,400	39.4%	Grant	Pre-existing intellectual property identified in agreement EPC-15-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	LightSail Energy	Ranked # 5
EPC-15-017 Utilizing Waste Heat to Increase Efficiency of Isothermal Compressed Air Energy Storage in a Smart Microgrid Environment	$89,979	$0	LightSail Energy	$811,645	42.8%	Grant	Pre-existing intellectual property identified in agreement EPC-15-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	LightSail Energy	Ranked # 6
EPC-15-052 ZipPower San Leandro	$158,370	$0	ZipPower, LLC	$486,000	24.5%	Grant	Pre-existing intellectual property identified in agreement EPC-15-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	ZipPower, LLC	Group 1: Ranked # 2
EPC-16-060 Adaptive Chargers for Delivery Customers Demonstrating California Advances in Charging	$818,672	$0	Motiv Power Systems, Inc.	$1,513,524	25.0%	Grant	Pre-existing intellectual property identified in agreement EPC-16-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Motiv Power Systems, Inc.	Group 4: Ranked # 2

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-15-011 Isothermal Compressed Air Energy Storage with Solar and Load Forecasting Integration		N/A	Yes; Calif Based Entity	This project will provide California utilities with information that can be used in assessing the costs and benefits of I-CAES to reduce the capital, installation and operation costs of the system. This constitutes a step towards meeting the Energy Commission targets of $1,000/kW, $200/kWh, and 80% round trip efficiency for energy storage.	1e, 1i, 4a, 5b	This project was terminated. LightSail Energy Inc. closed its energy storage division. No work was completed and no funds were disbursed for this project.
EPC-15-017 Utilizing Waste Heat to Increase Efficiency of Isothermal Compressed Air Energy Storage in a Smart Microgrid Environment		N/A	Yes; Calif Based Entity	To meet California's statutory energy goals AB32, AB2514, and the RPS extensive penetration of low-cost, high efficiency energy storage is needed. This project will provide California utilities with valuable information that can be used in assessing the costs, benefits and identifying the highest value applications of I-CAES for the California grid.	1e, 1i, 4a, 5b	This project was terminated. LightSail Energy Inc. closed its energy storage division. No work was completed and no funds were disbursed for this project.
EPC-15-052 ZipPower San Leandro		N/A	Yes; Calif Based Entity	SB 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings in existing buildings by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project was terminated. Throughout the term of the agreement, ZipPower, LLC requested significant budget changes, and numerous project team changes, resulting in insufficient progress and excessive delays, as well as low confidence from the Energy Commission in ZipPower, LLC's ability to build and maintain a successful project team.
EPC-16-060 Adaptive Chargers for Delivery Customers Demonstrating California Advances in Charging		N/A	Yes; Calif Based Entity	A future-focused approach that enables zero emission vehicles (ZEV) to be more cost competitive than diesel by enabling VGI through an on-board charger technology has the potential to reach a higher percentage of the California vehicle market. Compared with a more costly VGI approach that puts the power processing on the charge station, this approach has a greater chance of capturing the future heavy-duty ZEV market that is being supported through policy mandates such as the ZEV action plan, Sustainable Freight Plan, AB32 and SB32 emission reduction goals, and SB 350.	1e, 1h, 2a, 3f, 4a, 4b, 5b	This project was terminated. Internal business conditions prevented Motiv Power Systems, Inc. from fulfilling obligations under the agreement.

Investment Program Period	Program Administrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immediately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date:Contract/Grant Amount ($)	Funds Expended to date: In house expenditures ($)	Funds Expended to date: Total Spent to date ($)
2015-17 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-069 Demonstrate the Phase III functions of a PV smart inverter and a storage inverter.	Applied Research and Development	Demonstrate the eight phase III functions of smart inverters in the field. This project will test and validate the Phase III functions of a PV smart inverter and a storage inverter to support higher penetrations of solar on the feeder to the South Coast AQMD Headquarters in Diamond Bar, California. This agreement will test, validate, and demonstrate all eight Smart Inverter Working Group (SIWG) Phase III functions in a system composed of a PV smart inverter, a bi-directional storage inverter, using behind-the-meter solar and storage. This will increase circuit hosting capacity for solar and decrease distributed PV integration costs.	6/14/2017	No	Distribution	$2,729,943	$2,729,943	$0	N/A	$0
			Terminated with no funds spent as of December 31, 2018					**$11,040,638**	**$11,040,638**	**$0**	**$0**	**$0**

** Pursuant to Public Resources Code section 25711.5(h)(2) the Energy Commission may use a sole source or interagency agreement if it notifies JLBC at least 60 days prior to making the award and JLBC either approves or does not disapprove within 60 days following the notification. Following Energy Commission notification, JLBC approved or did not disapprove all Energy Commission sole source or interagency agreements and they were deemed authorized after 60 days.*

*** Projects include funds from EPIC Plan 2012-2014 and EPIC Plan 2015-2017, or more than one investment area. There is a total of 303 projects.*

****The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.*

***** Projects were approved at an Energy Commission Business Meeting, but later terminated by the recipient; however, no work was done on these projects and no EPIC funds were spent (Not included in project count and amount).*

******Funds Expended to date: In House Expenditures: Reporting of In-house Expenditures is required of the IOUs, but not the Energy Commission per CPUC D.13-11-025 page 51 and ordering paragraph 20.*

Note: Each amendment to a project with an adjustment to the EPIC encumbered funding amount is listed on a separate row.

Project Name	Administrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process
EPC-16-069 Demonstrate the Phase III functions of a PV smart inverter and a storage inverter.	$594,333	$0	South Coast Air Quality Management District; Advanced Microgrid Solutions, Inc.; Nemaste Solar	$2,173,382	44.3%	Grant	Pre-existing intellectual property identified in agreement EPC-16-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Advanced Microgrid Solutions, Inc.	Group 4: Ranked # 2
	$1,764,200	**$0**		**$5,763,951**							

Project Name	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-16-069 Demonstrate the Phase III functions of a PV smart inverter and a storage inverter.		N/A	Yes; Calif Based Entity, Woman Own	This project was to develop an advanced communications gateway and system controller to operate and demonstrate the use of Phase III functions for smart inverters and energy storage to enable greater use of distributed renewable energy resources.	1b, 4a, 5b	This project was terminated. Loss of the site where the work was to be performed, prevented Microgrid Solutions, Inc. from fulfilling the obligations under the agreement.