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ENERGY COMMISSION

California Energy Commission

COMMISSION REPORT

Electric Program Investment Charge 2020 Annual Report

Gavin Newsom, Governor

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California Energy Commission

David Hochschild
Chair

Commissioners
Karen Douglas, J.D.
Siva Gunda
J. Andrew McAllister, Ph.D.
Patty Monahan

Pamela Doughman
Primary Author

Tiffany Solorio
Project Manager

Erik Stokes
Manager
ENERGY DEPLOYMENT AND MARKET FACILITATION OFFICE

Laurie ten Hope
Deputy Director
ENERGY RESEARCH AND DEVELOPMENT DIVISION

Drew Bohan
Executive Director

ACKNOWLEDGEMENTS

The Electric Program Investment Charge 2020 Annual Report was prepared with contributions from the following staff:

Rizaldo Aldas
Scott Cox
Joshua Croft
Maggie Deng
Chuck Gentry
Rey Gonzalez
Adam Gottlieb
Mike Gravely
Braden Henderson
Alex Horangic
Yu Hou
David Hungerford
Abigail Jacob
Suzanne Korosec
Katrina Leni-Konig
Virginia Lew
Michael Lozano
Anthony Ng
Nicole O'Gara
Eleanor Oliver
Silvia Palma-Rojas
Jesselyn Rosales
Rachel Salazar
Martine Schmidt-Poolman
Linda Spiegel
Jonah Steinbuck
David Stout
Felix Villanueva
Ben Wender
Misa Werner
Susan Wilhelm

PREFACE

The California Energy Commission's (CEC) 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 2012, the California Public Utilities Commission (CPUC) established the Electric Program Investment Charge (EPIC) to fund public investments in research to create and advance new energy solutions, foster regional innovation and bring ideas from the lab to the marketplace. The CPUC selected the CEC and the state's three largest investor-owned electric utilities — Pacific Gas and Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company — to administer the EPIC funds and advance novel technologies, tools, and strategies that provide benefits to electric ratepayers.

The CEC awards EPIC research funds to projects that promote greater reliability, lower costs, increase safety for the California electric ratepayer, and meet the following guiding principles:

- Provide societal benefits
- Support mitigation and adaptation of greenhouse gas emissions in the electricity sector at the lowest possible cost
- Support 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
- Support low-emission vehicles and transportation
- Provide economic development
- Use ratepayer funds efficiently

In 2020, the CPUC renewed the EPIC for ten years, 2021 through 2030, and approved the CEC to continue as an EPIC program administrator.

For more information about the Energy Research and Development Division, please visit the CEC's website at https://www.energy.ca.gov/programs-and-topics/topics/research-and-development.

ABSTRACT

The California Energy Commission (CEC) is the state's primary energy policy and planning agency. As part of its overall mission, the CEC administers several clean energy research and development programs that drive innovation and advance science and technology in energy efficiency, renewable energy, energy-related environmental protection, energy transmission and distribution, and transportation. The CEC is one of the administrators of the state's Electric Program Investment Charge (EPIC). In administering EPIC, the CEC funds research, development, and demonstrations of clean energy technologies and approaches that will benefit electricity ratepayers of California's three largest investor-owned electric 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 CEC activities funded by EPIC from January 1, 2020, through December 31, 2020. The report was prepared in accordance with applicable California Public Utilities Commission decisions and California Public Resources Code Section 25711.5.

Keywords: Advanced generation, agriculture, buildings, California Energy Commission, California Public Utilities Commission, clean energy economy, climate change, decarbonization, demand response, disadvantaged community, distributed generation, Electric Program Investment Charge, electricity, electrification, energy efficiency, energy equity, energy policy, energy research, energy storage, entrepreneurial ecosystem, environmental, greenhouse gas, innovation pipeline, jobs, loading order, low-income community, ratepayer benefits, renewable energy, resilience, safety, smart grid, transmission, transportation, U.S. Department of Energy, water

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EXECUTIVE SUMMARY

Overview of Program/Plan Highlights

Through the Electric Program Investment Charge (EPIC), the California Energy Commission (CEC) funds innovation to advance a clean, safe, reliable, and affordable electricity system in California. Since the beginning of EPIC, the CEC has funded 385 project awards, encumbering about $846 million: $143 million for the entrepreneurial ecosystem, $151 million for resiliency and safety, $194 million for building decarbonization, $207 million for grid decarbonization and decentralization, $119 million for industrial and agricultural innovation, and $32 million for low-carbon transportation. In 2020, awardees completed 47 EPIC projects. Examples of the effect of CEC EPIC investments through 2020 include the following:

- Businesses raised $3.5 billion in private investment after receiving CEC funding and support, including $1.5 billion raised by start-up companies participating in the EPIC-funded entrepreneurial ecosystem.
- From a sample of 119 start-up companies seeking private investment, estimates indicate total private investment on average more than quadrupled after firms received an EPIC award, from about $450 million to more than $2 billion.
- More than 45 technologies and related services companies have been successfully commercialized, and dozens more are moving toward commercialization.
- Through December 2020, 33 percent of the CEC EPIC technology development and deployment funds has been invested in projects in disadvantaged communities (surpassing the 25 percent required), and an additional 32 percent has been invested in projects in communities that are low-income but not disadvantaged (surpassing the 10 percent required), as defined by Assembly Bill 523 (Reyes, Chapter 551, Statutes of 2017) and Senate Bill 535 (De León, Chapter 830, Statutes of 2012).
- More than 350 project sites in California have demonstrated new energy technology solutions with CEC EPIC funding, including more than 230 demonstrations in disadvantaged or low-income communities.
- EPIC projects have advanced more than 25 online tools that make complex information and data more accessible, scalable, and cheaper to operationalize. These online tools are estimated to have more than 850,000 users.
- Through 2020, there are more than 2,900 citations of publications showcasing results from EPIC-funded research.

Examples of additional benefits anticipated from completed, ongoing, and future research include the following:

- More than 30 EPIC projects have advanced technologies and approaches to improve the effectiveness of energy-related codes and standards, a key tool to enabling widespread diffusion of new technologies and data-driven practices. Three of these projects could lead to more than $700 million in annual energy cost savings if adopted in regulatory codes.
- The present value of on-bill savings projected through 2045 totals $18.6 billion from 19 EPIC-funded energy efficiency technologies, including a subset of 3 projects projected to result in $78.8 million in disadvantaged communities and additional millions of dollars in benefits in low-income communities that are not considered disadvantaged. The

present value of health benefits from improved air quality projected through 2045 from this set of 19 EPIC-funded energy efficiency technologies totals $85.9 billion to $191 billion, including a subset of 3 projects projected to result in $21.6 billion to $48 billion in disadvantaged communities and additional billions in benefits in low-income communities that are not considered disadvantaged. Examples of technologies in this analysis include solar-reflective "cool" walls, smart ceiling fans, and a low-global-warming potential, high-efficiency heat pump and air conditioner.

- Based on data available through April 2020, the investment of CEC EPIC funds, match funding, and follow-up funding is associated with an estimated $4 billion in value-added economic activity and 3,500 jobs per year from 2014 through 2024.

The CEC awards EPIC funds through a competitive process to accelerate the most promising technologies and approaches across a range of high-priority topics, including the entrepreneurial ecosystem, resilience and safety, building decarbonization, grid decarbonization and decentralization, industrial and agricultural innovation, and transportation.

Entrepreneurial Ecosystem

The CEC invests EPIC funds to build a well-integrated entrepreneurial ecosystem of businesses and innovators focused on clean energy in California. The entrepreneurial ecosystem provides seed funding through the California Sustainable Energy Entrepreneur Development Initiative (CalSEED). With funding from EPIC, New Energy Nexus runs the CalSEED initiative, which assesses applications from clean energy startup companies, submits proposed small grant awardees for consideration by the CEC, and provides business development training for participating startup companies. The entrepreneurial ecosystem also includes:

- The CEC EPIC CalTestBed Initiative, administered by New Energy Nexus, awards vouchers to competitively selected clean energy companies to reduce the cost of access to prototype testing centers in California. Through the EPIC-funded CalTestBed program 26 clean energy start-up companies gained access to California's premier testing facilities to collect validated performance data to share with potential investors.
- Competitive funding through the BRIDGE funding opportunity, which stands for bringing rapid innovation development to green energy. This component of the entrepreneurial ecosystem provides additional funding for the most promising clean energy technologies that were previously funded through an eligible CEC or federal program and have already attracted interest from the market as they are developed and continue the path to market adoption.
- Competitive funding for realizing accelerated manufacturing and production for clean energy technologies (RAMP). This component of the entrepreneurial ecosystem provides funding to help clean energy entrepreneurs successfully advance their emerging best-of-class innovative technology from one-off production to a pilot production line for manufacturing in California.
- Business development support through four innovation clusters located across California: Los Angeles Cleantech Incubator, Clean Tech San Diego, Blue Tech Valley, and Cyclotron Road.

Start-ups participating in the entrepreneurial ecosystem are working to address key technology challenges in California. For example, NeoCharge Corporation is working on reducing the installation cost of electric vehicle chargers. NeoCharge Corporation received seed funding

from CalSEED and business development support from the Los Angeles Cleantech Incubator. NeoCharge Corporation is developing a technology that can enable installation of at-home vehicle charging without upgrading the electrical supply panel, helping reduce the installation cost of electric vehicle chargers. Including permits, labor, and parts, the average cost of installing a typical residential electric vehicle charger is about $1,500. In contrast, the average cost of the NeoCharge electric vehicle charging technology is $450. Compared to a 120V outlet, the NeoCharge electric vehicle charging technology provides 7 times faster charging.

Through December 2020, the entrepreneurial ecosystem has achieved the following milestones:

- Start-up companies participating in CalSEED or one of the innovation clusters have attracted more than $1.5 billion in subsequent investment after joining the EPIC-funded entrepreneurial ecosystem, including more than $984 million in private investment.
- About $3.45 million in CalSEED funding has been awarded to start-up companies operating in underresourced communities.
- The EPIC RAMP initiative increases the number of clean energy manufacturing jobs in California. Through December 2020, RAMP companies have hired 65 skilled workers since receiving RAMP funding, and they are expected to hire more than 180 additional workers by the time their participation in RAMP is completed. Before funding from RAMP, this group of companies employed a total of 55 skilled workers.

Resilience and Safety

With climate change, more frequent extreme heat waves and fires are affecting California. For example:

- As stated in the January 2021 *Final Root Cause Analysis* prepared by the California Independent System Operator (California ISO), California Public Utilities Commission (CPUC), and CEC, a historic extreme heat event in the western United States in August 2020 challenged the ability of imported and in-state energy resources to meet net peak demand in California. Net peak demand is the highest electricity consumption net of solar and wind energy resources.
- According to data from the California Department of Forestry and Fire Protection (CAL FIRE), by mid-October 2020, wildfires burned more than 4 million acres in California — more than double the total area burned in the devastating fire season of 2018. Six of the top 20 largest wildfires in California occurred in 2020.

The CEC EPIC advances understanding of climate science and funds technological innovation to strengthen resilience and safety. These investments address challenges such as reducing peak demand, improving flexibility in the amount and timing of energy use, and maintaining local energy supply to critical infrastructure during heat waves, public safety power shutoffs, and other difficult conditions.

For example, Caban Systems, Inc., a technology company that offers clean energy products for stand-alone and backup power, received an EPIC grant as one of the entrepreneurial ecosystem RAMP projects awarded funding in 2019. Caban is developing software-enabled modular energy storage system for telecommunication towers and other critical infrastructure. This technology offers a cleaner, more robust, low-maintenance alternative to diesel back-up generators. Caban's battery systems are built to survive harsh environments up to 131° F and

provide easy integration with on-site renewable generation. It takes less than one day to install and commission Caban's energy storage system at a telecommunication tower. With Caban's energy storage system, it takes less than a blink of an eye to bring a telecommunications tower back online once it has lost power from the grid. Caban's energy storage system restores power in less than 10 milliseconds. With EPIC funding, Caban has been able to increase production capacity of its energy storage solution 30 times, from one unit per month to one unit per day, enabling the company to meet customer demand for its energy storage product. Since beginning this project, this start-up company has created 6 manufacturing jobs and plans to add another 19 manufacturing jobs by the end of the project.

The CEC has invested $43 million in EPIC funds to advance long-duration energy storage technologies (10 to 100 hours), including more than $13 million for energy storage projects benefitting tribal communities through December 2020, milestones achieved by EPIC investments in resilience and safety include the following:

- Recipients brought $41 million in match funding for a total investment of $84 million.
- These projects will strengthen local resilience to extended outages, such as multiday outages that affect rural areas following high wind conditions. CEC-funded microgrids provided 5 MW of load reduction during the multistate heat wave in August and September.

Building Decarbonization

To achieve California's greenhouse gas reduction goals and reduce electricity bills, the CEC invests EPIC funds in technologies that deliver cost savings in energy efficiency and demand flexibility. Energy costs disproportionally affect low-income families, whose homes are often older with less insulation and fewer efficiency measures, and because they often rent, they depend on building owners to improve the comfort, healthfulness, and energy efficiency of their homes and apartments. Building owners often lack information on the impacts and ease of upgrades. The Electric Power Research Institute (EPRI), a membership-based nonprofit organization that conducts energy and environmental research informed by electric utilities in the United States and other countries, is completing a CEC EPIC project to reduce costs of nonintrusive energy efficiency retrofits for multifamily buildings in disadvantaged communities.

Working with LINC Housing Corporation, a nonprofit organization that builds and manages affordable housing, EPRI installed energy efficiency upgrades, including a Sanden heat pump water heater, on a multifamily apartment complex in Fresno (Fresno County). The Sanden heat pump water heater uses carbon dioxide, an ultralow global-warming-potential refrigerant. Using the water heater to supply residential units eliminated the need for electrical upgrades to each apartment, saving more than $1,200 per apartment. These savings were accomplished by using one Sanden heat pump to serve the hot water needs of multiple apartments, rather than using individual heat pump water heaters for each apartment. Combining hot water service for several apartments using Sanden heat pumps has not been demonstrated in the past in a setting with monitoring to verify energy savings, benefits, and performance. This heat pump technology, along with other implemented retrofit solutions, can reduce energy use in the Fresno complex by 30 percent to 40 percent. The heat pump also reduces onsite emissions from the natural gas water heaters it replaces. Results from this project will inform a multifamily retrofit guidebook to help building owners and operators select technologies for retrofits.

Through December 2020, EPIC investments with the potential to contribute to building decarbonization include:

- Existing multifamily residential buildings: a project with EPRI demonstrated an approach to scale residential retrofits for disadvantaged communities using customer-centric solutions. This project demonstrated savings between 30 percent and 40 percent total building energy consumption from installing high efficiency heat pumps. These high-efficiency units were installed without the need for electrical infrastructure upgrades. This project demonstrated the use of natural refrigerant (carbon dioxide) heat pump water heaters serving multiple units. This project successfully overcame the barrier of needing to upgrade electric panels to decarbonize multifamily buildings. The project included space-conditioning heat pumps that can be plugged into standard outlets. The space conditioning heat pump is a new product in the United States and is unique in that it can be directly plugged into a standard 120-volt outlet and eliminates the need to upgrade the electrical panels in apartments, which are often small.
- Existing single-family homes: saving between 39 percent and 50 percent for space-conditioning savings. Various technologies could be incorporated into heat pumps to increase energy efficiency. These technologies included variable-capacity compressor and variable-speed fans, integrated ventilation for free cooling, zonal controls, demand response, advanced fault detection and diagnostics controls that can quickly identify equipment performance issues, and use of alternative refrigerants with low global warming potential. One project tested prototype units containing many of these measures to determine energy savings and performance. Based on the results, Daikin, a partner on the project, has incorporated variable-capacity compressor, variable indoor blower fan, and fault detection and diagnostics technologies into its future heat pump offerings, and its heat pumps are compatible with one of its thermostats with automatic demand-response capabilities.
- Existing commercial buildings: saving nearly 30 percent for space-conditioning savings. One project demonstrated a hybrid space-conditioning system as an alternative to rooftop units. The hybrid configuration combined a highly efficient variable refrigerant flow system with indirect evaporative cooling and operational enhancement through the building control system. The advanced controller synchronized operation of both systems to reduce energy use and peak energy demand and maximize occupant comfort.
- Prefabricated mobile homes: potential to save 40 percent in space conditioning through improvements in the building envelope. Two projects were funded to develop and test advanced envelope measures for affordable, all-electric, and fire-resilient mobile homes that can meet California's building energy efficiency standards. One project includes innovative wall and roof systems, such as use of metal skin sandwich panels with foam, mineral wool/fiberglass, or use of vacuum panel insulation or sealed attic approaches. The other project will use vacuum-insulation-panel-based prefabricated envelope systems with excellent insulation performance, along with use of air- and water-resistive barrier technology. Both projects will result in the construction of highly efficient prefabricated mobile homes, with some being demonstrated in under resourced communities.
- More than 14 products for building decarbonization (such as liquid cooling and thermal management systems for data centers and advanced plug-load controllers) have been

commercialized or advanced as result of performance testing provided through EPIC-funded projects.

Grid Decarbonization and Decentralization

Recent Senate Bill (SB) 100 (De León, Chapter 312, Statutes of 2018) projections provided in the *2021 SB 100 Joint Agency Report* call for a sustained record-setting rate of building new renewable electricity supply to achieve California's 100 percent clean electricity goal for 2045. To achieve this goal, the core scenario of the report adds 2.8 gigawatts (GW) per year for solar energy systems and 0.9 GW per year for wind turbines. The core scenario for SB 100 also calls for adding 2.0 GW of energy storage per year for the next 25 years. Energy storage costs have dropped substantially over the past 10 years. However, achieving this pace of energy storage expansion will require technological advancements to reduce energy storage technology and support system costs, continue to simplify and streamline interconnection, extend the duration of energy storage from 3 to 6 hours to 10 to 100 hours, and reduce lithium-related environmental impacts and supply chain constraints.

Energy storage is a central component of California's clean energy future, and lithium-based energy storage technologies play a central role in electric vehicles and other energy storage applications. The CEC is investing EPIC funds to advance environmentally friendly technologies to increase California's production of lithium from geothermal brine in the Salton Sea area in Imperial County. For example, SRI International, a nonprofit science and technology research institute based in Menlo Park (San Mateo County), developed an innovative sorbent material and regeneration process to capture lithium from geothermal brine and directly produce lithium carbonate, a metallic salt used to make lithium batteries for electric cars and stationary applications. The new sorbent regeneration uses ecofriendly carbon dioxide and carbonic acid that lead to the direct formation of high-purity lithium carbonate. The technology was licensed to ExSorbtion, Inc., a research-driven technology corporation focused on lithium extraction, to pursue commercialization. In 2020, subsequent EPIC funding was awarded for a pilot demonstration with ExSorbtion as a subcontractor. Based on performance demonstrated in a laboratory setting, this emerging technology can recover 90 percent of lithium from geothermal brine. Conventional lithium recovery methods have less than 50 percent efficiency. Also, the upfront costs for this technology are more than six times lower than the upfront costs for conventional lithium recovery methods.

Through December 2020, milestones achieved by EPIC investments in grid decarbonization and decentralization include:

- $14 million invested in five new RD&D projects in 2020 to improve the production and flexibility of existing geothermal plants and demonstrate the economic capture of lithium from geothermal brines that will advance the Lithium Valley vision for California's Salton Sea area. These projects are working toward unlocking the potential $6 billion in annual economic value projected from the lithium that could be produced from geothermal brine at the Salton Sea, based on a price of $10,000 per metric ton lithium carbonate equivalent. The estimated potential lithium carbonate production from the Salton Sea area is 600,000 tons per year, enough to produce about 11.3 million electric vehicle batteries each year.
- Projected annual savings of $0.8 million to $1.6 million in drilling costs at The Geysers, a large group of geothermal power plants in Sonoma and Lake Counties, due to improved drilling targets if results from a CEC EPIC project are implemented. The

project designed and developed a high-resolution imaging system using a dense network of low-cost seismic sensors to improve knowledge of subsurface fluid flow.

- $8 million invested in five new applied research and development projects in 2020 for land-based and offshore wind energy, including real-time monitoring systems and environmental risk assessment.
- Up to $60 million annually in projected cost savings from legacy wind turbines if results from an EPIC project are implemented to enable response to oversupply and low wind conditions. The project developed and demonstrated low-cost, standardized innovative controls that add automated dispatch capability and flexibility to legacy wind turbines.

Industrial, Agricultural, and Water Innovation

In combination, California's industrial, agricultural, and water sectors use more than 20 percent of electricity consumed in California. Innovation can help reduce electricity bills in these economically vital sectors and help California achieve its clean energy goals. For example, because hydraulic pumps are so widely used in industrial and agricultural processes, improving the efficiency of these pumps could yield substantial energy savings. There are more than 124,000 hydraulic power motors currently in use in California's industrial, agricultural, and water sectors. Terzo Power Systems, LLC, a hardware technology company, has developed a hydraulic pump unit that replaces valves with a permanent magnet, increasing efficiency by 80 percent compared to state-of-the-art hydraulic pumps. The combination of efficient motor controllers and an integrated liquid cooling loop yields excellent energy efficiency while reducing cost, size, weight, and noise. Terzo's Hydrapulse hydraulic pump unit is more than 80 percent smaller and lighter than a conventional hydraulic pump unit.

Through December 2020, EPIC investments achieved the following milestones in industrial and agricultural innovation:

- Seven technologies for industrial, agricultural, and water applications were made commercially available or advanced as a result of performance testing provided through EPIC-funded projects. Examples of these technologies include energy and water management systems that improve agricultural energy efficiency and a product concentration system using forward osmosis.
- More than 100,000 acres of farmland are using energy- and water-saving and load-reduction technologies advanced through EPIC funding.
- About $307 million in follow-up funding was provided for industrial, agricultural, and water innovation.

Transportation

As stated in the CEC's *2019 Integrated Energy Policy Report*, eliminating emissions from the transportation sector is critical to the state's climate and clean air goals. Taking refinery emissions into account, about half of California's greenhouse gas emissions come from the transportation sector. Furthermore, the California Air Resources Board 2020 Estimated Annual Average Emissions indicate more than 75 percent of nitrogen oxide emissions in California come from the transportation sector.

In 2020, Governor Gavin Newsom accelerated work to reduce pollution from the transportation sector by setting a bold new target in Executive Order N-79-20: by 2035, all new cars and

passenger trucks sold in California will be zero-emission vehicles, with all medium- and heavy-duty vehicle sales following by 2045. Zero-emission vehicles are a key part of California's clean innovation economy — already California's second largest global export market.

The CEC is investing EPIC funding to advance electric vehicle charging and vehicle-grid technologies to realize the potential for millions of new electric vehicles to enhance load flexibility for California's electricity system. Nuvve Corporation, a technology company specializing in bidirectional, interactive electric vehicle charging systems, used EPIC funding to develop and demonstrate vehicle-grid integration technologies for managing aggregated plug-in electric vehicle charging and discharging within the UC San Diego microgrid. A microgrid is a combination of local electricity generation sources, energy storage, and loads that act as a small electric grid and can operate interconnected or isolated from the main electric grid.

The Nuvve flexible market participation platform allowed plug-in electric vehicles and other distributed energy resources on campus to support the California ISO through the Demand Response Auction Mechanism, a method for selling demand response into the day-ahead energy market, including load reduction of more than 1.2 MW during California's summer 2020 extreme heat-related rolling blackouts. Nuvve's control system for three bi-directional EV chargers demonstrated up to $800 monthly savings in electricity bills at a UC San Diego campus parking garage.

In 2020, the solutions demonstrated by Nuvve received more than $18 million in subsequent private capital investment and Nuvve is planning a public listing with a valuation potentially exceeding $100 million. Recognizing its potential impact on expanding access to the use of renewable energy to fuel electric vehicles, Nuvve was awarded two California Visionary Awards at the 2020 EPIC Symposium — Best in Storage and Mobility and Biggest Impact for Energy Equity. Nuvve participates in the EPIC-funded Southern California Energy Innovation Network, which provides business development services for clean energy technologies.

Other examples of EPIC investments accelerating development of transportation technologies include the following:

- A project with ChargePoint demonstrated potential for about $450 savings for home charging per plug-in electric vehicle per year. As discussed at an *Integrated Energy Policy Report* workshop on August 6, 2020, NREL projects more than 80 percent of plug-in electric vehicles will charge at home in 2030. According to data from the California Department of Motor Vehicles, the population of plug-in electric vehicles California through 2019 was nearly 560,000. If 10 percent of these vehicles adopt managed charging technologies, savings for electric vehicle charging could exceed $20 million per year in California. By shifting charging away from the late afternoon and early evening, this technology can also help avoid outages during extreme heat events.
- A project with Greenlots estimated potential for up to $1,000 savings per month from reduced demand charges at a public electric vehicle charging site with four direct-current (DC) fast chargers and co-located stationary storage. As reported on the CEC Zero Emission Vehicle and Infrastructure Statistics web page, through 2019, there were only 5,300 DC fast chargers installed in California. In August 2020, a preliminary NREL estimate projected deployment of DC fast chargers to reach state electrification goals could be about 35,000 by 2030. If 10 percent of these DC fast-charger deployments adopt this technology, demand charge reduction savings could total $1.6 million per

year; including installed DC fast chargers, the savings could grow to more than $10.5 million per year by 2030.

EPIC Advances Energy Equity

Essential to a just and fair transition, California is expanding opportunities for participation of disadvantaged and low-income communities, tribes, and rural communities in the development of California's clean energy economy. Through 2020, more than $221 million (65 percent) of CEC EPIC technology demonstration and deployment funds have been invested in projects with demonstration sites in low-income communities or disadvantaged communities, as defined by AB 523. Including additional projects benefitting California Native American tribes brings the total to 68 percent.

Staff estimates there may be 2 million low-income multifamily housing units in need of energy-efficient retrofits in California. In 2020, the CEC hosted a building decarbonization technology forum. Many of the EPIC-funded projects featured at the forum are advancing access to clean energy in disadvantaged and low-income communities. For example:

- Building-envelope retrofits are critical to improving energy efficiency and reducing energy costs for residents but are rarely included in renovations because of cost, time constraints, and disruption to occupants. Multifamily buildings are especially challenging to retrofit. The Rocky Mountain Institute is assessing the commercial feasibility of using prefabricated exterior envelope panels through a demonstration project in a multifamily building in a Northern California disadvantaged community. These panels, placed over existing exteriors, could decrease the cost, time, and complexity of retrofitting multifamily buildings, better sealing the building and reducing residents' energy costs. On average, it takes three weeks to insulate, seal, and weatherize the building-envelope using conventional approaches, but it takes less than one week using the panelized approach being demonstrated in this EPIC project. Compared to standard retrofit methods, this panelized approach could reduce energy use for space heating and cooling more than 20 percent due to insulation, air tightness and use of higher quality manufactured prefabricated retrofit façade panels.
- Space conditioning and water heating are a significant part of California's energy demand and the state needs more efficient space conditioning and water heating retrofit solutions, especially in multifamily buildings. The Association for Energy Affordability, Inc., a nonprofit organization providing technical services for energy efficiency in buildings, is developing, testing, and demonstrating a prefabricated, scalable central mechanical system module for multifamily buildings. The module includes a heating, ventilation and air-conditioning (HVAC) unit and a separate water heater. The systems will be tested in buildings in disadvantaged or low-income communities. By packaging the mechanical systems in modules, this technology could reduce the cost and time needed to accelerate energy efficiency retrofitting for multifamily units.
- Building more affordable and less energy intense homes is part of easing California's housing challenges. The Gas Technology Institute is partnering with Habitat for Humanity to build two affordable and high-energy-performing homes in Stockton (San Joaquin County). These homes incorporate innovative design and construction approaches, such as windows located and sized to fit the framing layout, all plumbing fixtures located near each other to minimize hot water piping and reduce hot water

waste, and ducts and HVAC equipment in conditioned space for thermal efficiency. The homes also include advanced energy efficiency measures, such as high-performance windows, above-code attic and raised wood floor insulation, and high-efficiency HVAC systems, including minisplit heat pumps with no auxiliary heating. These homes demonstrate affordable construction cost but with lower operating costs for residents than standard construction. The techniques used in these homes could become standard construction practice, leading to widespread deployment of affordable zero-net-energy homes. In addition, the project will develop a guide to affordable residential zero-net-energy design and construction, training curriculum, and new class offerings for building practitioners.

Status of the Electric Program Investment Charge

In 2020, in Decision 20-08-042, the CPUC renewed the EPIC for 10 years, 2021 through 2030, and approved the CEC to continue as an EPIC program administrator. The CEC has a budget of $147.26 million per year for the first five years of the renewed EPIC. The CPUC ordered the investor-owned utilities to collect funds for the renewed EPIC starting January 1, 2021, and directed the CEC to file an investment plan to the CPUC by October 1, 2021, to cover the period of January 1, 2021, through December 31, 2025.

The CEC looks forward to building on successes to date and further accelerating clean energy innovation in the development pipeline to enable California to meet its clean energy mandates and aspirations more effectively and efficiently. CEC EPIC investments provide critical validation of performance, cost savings, and safety of new clean energy technologies for policy makers, private sector investors, and customers. Also, CEC EPIC investments accelerate the pace of innovation and technology scale-up by publicly sharing project results. As a result, future activities can build on successes and lessons learned.

What's Next for the Electric Program Investment Charge

The next EPIC Investment Plan is due to the CPUC by October 1, 2021. Because the CPUC will need time to consider the plan through a public proceeding, approval is not expected until early 2022. To maintain continuity in EPIC funding opportunities and continue to stimulate economic growth as California's economy recovers from the COVID-19 pandemic, the CEC submitted its interim investment plan on February 16, 2021 and is seeking accelerated CPUC approval of an EPIC Interim Investment Plan for funds collected in 2021. The interim investment plan focuses on reliability, resilience, and initiatives to scale-up deployment of energy storage, demand response, and clean energy generation technologies.

Looking forward, the CEC plans to hold scoping workshops in spring 2021 to inform development of the CEC EPIC Investment Plan for funds collected 2022–2025.

CHAPTER 1:
Introduction and Overview

Background on the Electric Program Investment Charge

In 2012, the California Public Utilities Commission (CPUC) established the Electric Program Investment Charge (EPIC) to promote greater reliability, reduce costs, and increase safety for California electric ratepayers. In administering EPIC, the California Energy Commission (CEC) funds research, development, and demonstrations of clean energy technologies and approaches that will benefit the electricity ratepayers of California's three largest investor-owned electric utilities. Using a competitive selection process, the CEC awards EPIC funding to advance technological breakthroughs and accelerate the achievement of the state's statutory energy goals, including goals to reduce greenhouse gas emissions, adapt to climate change, improve energy efficiency, advance renewable energy, support low-emission transportation, and expand economic development.

The CEC's administration of EPIC responds to and informs state energy policy. State law directs the CEC to help achieve the state's statutory energy goals by investing in a strategically focused portfolio of projects designed to address the most significant technological barriers and challenges. The CEC has developed portfolios of research grouped into six investment topics aligned to address the state's energy policies and CPUC proceedings. Table 1 shows how the CEC EPIC investment topics map to state policies and CPUC proceedings.

Table 1: California Energy Commission Electric Program Investment Charge Investment Topics Mapped to Policies and Proceedings

Investment Topics	State Policies and CPUC Proceedings
Entrepreneurial Ecosystem	SB 32 (Stats. 2016, ch. 249) SB 350 (Stats. 2015, ch. 547) SB 96 (Stats. 2013, ch. 356) AB 327 (Stats. 2013, ch. 611) AB 2514 (Stats. 2010, ch. 469)

Investment Topics	State Policies and CPUC Proceedings
Resilience and Safety	SB 1339 (Stern, Chapter 556, Statutes of 2018) SB 901 (Dodd, Chapter 626, Statutes of 2018) SB 379 (Jackson, Chapter 608, Statutes of 2015) SB 246 (Wieckowski, Chapter 606, Statutes of 2015) AB 1482 (Gordon, Chapter 603, Statutes of 2015) AB 2514 (Skinner, Chapter 469, Statutes of 2010) Ex Order B-52-18 R.20-08-020 R.20-05-003 R.19-09-009 R.19-01-011 R.18-12-005 R.18-07-003 R.18-04-019 R.17-09-020 R.17-07-007 R.14-10-003 R.14-08-013
Building Decarbonization	SB 100 (De León, Chapter 312, Statutes of 2018) SB 1477 (Stern, Chapter 378, Statutes of 2018) AB 3232 (Friedman, Chapter 373, Statutes of 2018) SB 350 (De León, Chapter 547, Statutes of 2015) AB 2137 (Quirk, Chapter 290, Statutes of 2014) AB 758 (Skinner, Chapter 470, Statutes of 2009) R.19-01-011 R.17-07-007 R.17-09-020 R.15-03-010 R.13-11-005 R.13-09-011
Grid Decarbonization and Decentralization	SB 100 (De León, Chapter 312, Statutes of 2018) AB 2868 (Gatto, Chapter 681, Statutes of 2016) SB 350 (De León, Chapter 547, Statutes of 2015) AB 2514 (Skinner, Chapter 469, Statutes of 2010) Commission DER Action Plan R.20-08-020 R.20-05-003 R.19-01-011 R.18-07-003 R.17-09-020 R.17-07-007 R.14-10-003 R.14-08-013

Investment Topics	State Policies and CPUC Proceedings
Industrial and Agriculture Innovation	Sustainable Groundwater Management Act (Water Code, Section 10720, et seq.) SB 32 (Pavley, Chapter 249, Statutes of 2016) SB 1383 (Lara, Chapter 395 Statutes of 2016) Ex Order B-37-16 R.19-01-011 R.17-09-020 R.17-07-007 R.13-11-005 R.13-09-011 R.13-02-008
Transportation	SB 676 (Bradford, Chapter 484, Statutes of 2019) AB 2127 (Ting, Chapter 365, Statutes of 2018) Executive Order N-79-20 R.18-12-006 R.17-07-007

Source: California Energy Commission

Table 2 summarizes quantifiable impacts and benefits that CEC EPIC-funded projects have achieved through 2020. The impacts are grouped into the following categories: technology advancement and commercialization, technology diffusion, knowledge generation and dissemination, and diversity and equity.

Table 2: Quantifiable Benefits of California Energy Commission Electric Program Investment Charge Investments by Impact Category

Impact Category	Quantifiable Benefits Through 2020
Technology Advancement and Commercialization	• Companies that have received EPIC funding or support have collectively received more than $3.5 billion in follow-up private investment, significantly leveraging EPIC's initial investment. • EPIC recipients were able to leverage their EPIC awards to attract nearly $180 million in federal and state (non-EPIC) funding. • More than 45 technologies and related services companies have been successfully commercialized. • Twenty companies supported by EPIC have executed successful exits, defined as a merger, acquisition, public offering, or secondary transaction. These exits are a notable measure of market interest in the technologies developed using EPIC funding.

Impact Category	Quantifiable Benefits Through 2020
Technology Diffusion	• More than 30 EPIC projects have advanced technologies and approaches to improve the effectiveness of energy-related codes and standards, a key tool to enabling widespread diffusion of new technologies and data-driven practices. • Three of these projects could lead to more than $700 million in annual energy cost savings if adopted in regulatory codes. • 730 organizations have been funded by EPIC across California. • The CEC has built an extensive EPIC network with its Empower Innovation platform, which has surpassed 2,000 members.
Knowledge Generation and Dissemination	• EPIC conducted two public forums to share research results (on Resiliency and Building Decarbonization) as well as the EPIC Annual Symposium. Total attendance at these three events exceeded 2,000. • Through 2020, results of CEC EPIC-funded projects have been published in more than 460 academic publications with more than 2,900 citations. These citations include more than 130 final project reports with more than 15,800 views. • EPIC projects were viewed more than 127,700 times by more than 11,500 users on the Energy Innovation Showcase, CEC's online project database. • EPIC projects have advanced more than 25 online tools that make complex information and data more accessible, scalable, and cheaper to operationalize. These tools are estimated to have more than 850,000 users.
Diversity and Equity	• Sixty-five percent of the CEC's technology demonstration and deployment funds have gone to projects located in and benefitting low-income or disadvantaged communities as defined by AB 523. • Although not a program requirement, more than $21 million has gone to projects benefitting California Native American Tribes, including the world-renowned microgrid at the Blue Lake Rancheria in Humboldt County. • 22 percent of EPIC agreements include a women-, minority-, or LGBTQ-owned business as the prime recipient or a subcontractor. •In 2020, CEC staff and EPIC recipients participated in 25 outreach and community events to promote knowledge about EPIC funding opportunities.

Source: California Energy Commission

Accelerating Commercialization of New Technologies

EPIC brings new investment to California by validating the merits of new energy technologies and connecting technology developers with business development experts. These resources

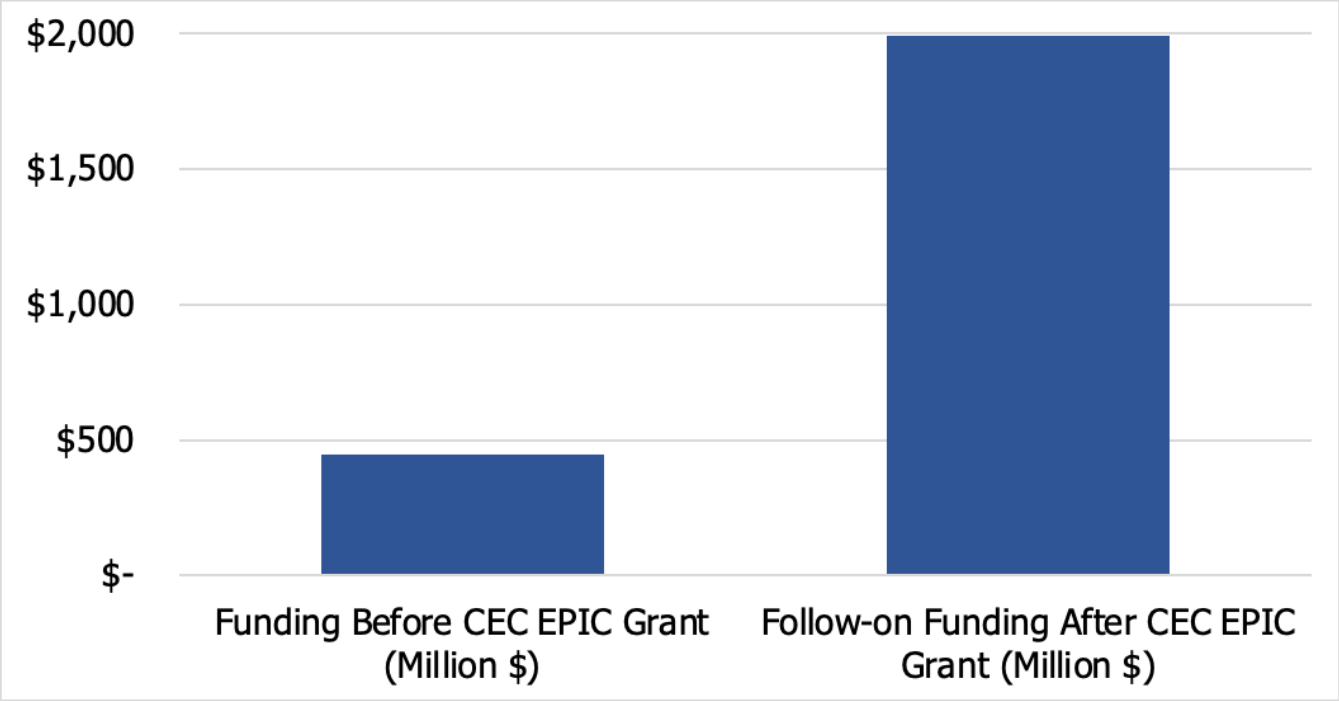
help expedite learning needed to develop new products and bring them to market. Through 2020:

- More than 45 technologies and related services companies have been successfully commercialized.
- Twenty start-up companies the CEC has funded through EPIC have gone through successful exits, defined as a merger, acquisition, or secondary transaction.

From a sample of 119 start-up companies seeking private investment, available data indicate total private investment on average more than quadrupled after firms received an EPIC award, from about $450 million to nearly $2 billion (Figure 1).

In addition to attracting private investment, a key benefit of state-funded research and development programs is the ability to attract and leverage federal funding to California. Leveraging federal funding provides efficient use of EPIC funding, one of the guiding principles of EPIC.[1]

Figure 1: Follow-On Private Funding for Selected Companies Before and After Receiving California Energy Commission Electric Program Investment Charge Award (Million $)



Data do not include CEC funding or recipients that first received EPIC funding in 2020. This information is current as of 12-30-2020.

Source: Pitchbook

Table 3 shows the match and leveraged funds attracted to California by CEC EPIC projects. For every million dollars of CEC funding, partners contributed more than $850,000 dollars in match and leveraged funding as part of the project award.

1 The guiding principles for EPIC are stated in CPUC Decision 12-05-037.

Table 3: Total Match and Leveraged Funds

Match Funds ($Million)	Leveraged Funds ($Million)	EPIC Funding Awards ($Million)	Match Plus Leveraged as Percentage of EPIC Awards
$447	$278	$846	86 percent

Match funds are funds contributed by partners as part of the project award. Leveraged funds are not the same as match funds. Leveraged funds are funds attracted from federal agencies or other interested parties that are external to the agreement to further develop the concept or technology.

Source: California Energy Commission

Electric Program Investment Charge Program Components

CPUC Decision 12-05-037, issued in May 2012, approved the CEC to administer 80 percent of EPIC funds. The CPUC has approved the CEC use of EPIC funds in the following investment areas:

- Applied research and development: This area includes 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: This area includes 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. Even the most forward-looking customers are unwilling to adopt new energy technologies without real-world demonstrations to verify and validate the technology's performance. Demonstration projects provide developers, investors, and potential customers with information about the cost, performance, safety, and reliability of the technology when used in a typical operational setting. In this stage, technology transitions from the small-scale, controlled setting of a prototype to the larger scale necessary for commercial deployment, allowing developers to address problems that arise from operating in real-world conditions and reducing technological, regulatory, and business risks to levels that would allow private investment in the first few commercial projects.
- Market facilitation: This area consists of activities to support clean energy technology and strategy implementation. In the 2018–2020 CEC EPIC Investment Plan, the CEC focused on the following market facilitation activities: commercialization assistance, local government regulatory assistance and streamlining, market analysis, and program evaluation to support deployment and expand access to clean energy technology and strategies. In previous CEC EPIC investment plans, market facilitation activities included incubating statewide clean energy innovation and entrepreneurship efforts, reducing barriers to launching emerging clean energy solutions, developing the workforce needed to achieve the state's energy goals, encouraging greater participation from diverse businesses and communities, promoting regulatory assistance and permitting,

researching markets, tracking programs, educating and reaching out to the public, and launching strategies. 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.

Chapter 2 summarizes total EPIC funding for CEC activities. 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 clearly matches strategic initiatives 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, CEC EPIC Project Write-Ups, and Appendix C CEC EPIC Project Status Report.)

Electric Program Investment Charge Program Regulatory Process

The CPUC oversees the CEC's administration of EPIC funds, including approving the CEC's EPIC Investment Plans. In addition, the state Legislature must grant the CEC 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 EPIC decisions to date. To ensure consistent reporting among all four administrators, those decisions specify the outline and contents of this report, including project reporting requirements. The CEC also provides this EPIC Annual Report to the Legislature, following California Public Resources Code Section 25711.5, and makes the report publicly available on its website.

Coordination

In 2020, the CEC continued to build partnerships and collaboration across diverse stakeholder groups, including activities to engage networks and partnerships and coordinate with EPIC administrators and other energy innovation efforts.

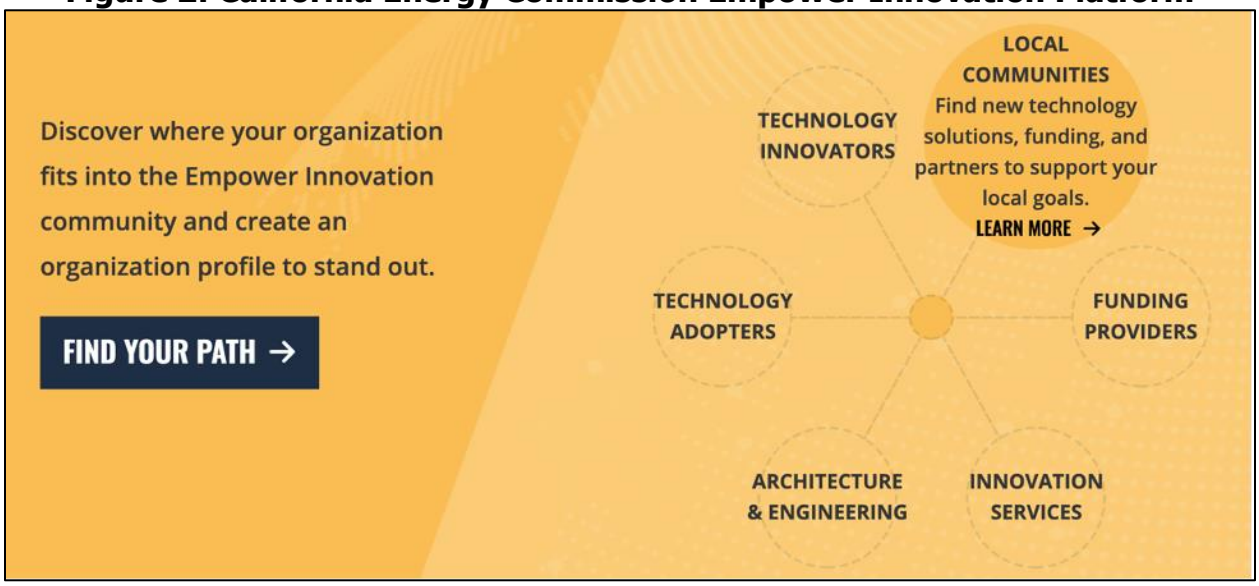
Engaging Networks and Partnerships

Launched in 2019, Empower Innovation is the first clean energy networking platform designed for professionals working on building a clean energy economy for everyone.

Participation in the platform has grown quickly. As of December 2020, the Empower Innovation platform[2] had more than 1,800 members with more than 530 organizations and more than 187,000 page views, as well as announcements of more than $10 billion in funding opportunities. In 2020, CEC staff held 20 networking demonstrations and events through the Empower Innovation platform.

2 The Empower Innovation Web platform is available online at https://www.empowerinnovation.net/.

Figure 2: California Energy Commission Empower Innovation Platform

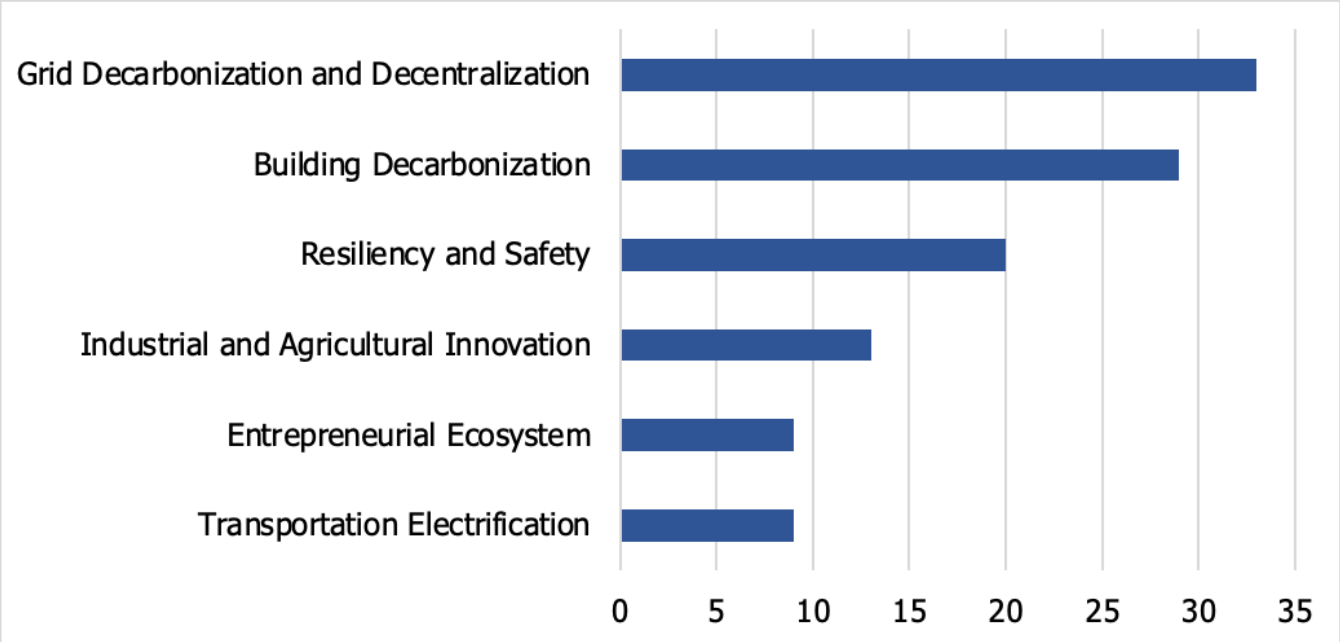


Source: Empower Innovation, an initiative funded by the California Energy Commission, https://www.empowerinnovation.net/

Electric Program Investment Charge Projects Promote Partnerships

Participation from a broad range of stakeholders helps ensure that local insights and concerns inform the products resulting from demonstration and market facilitation projects. This information can help accelerate access and adoption of clean energy innovation across California. Figure 3 shows EPIC projects with three or more stakeholder group types. These partnerships are intentional and are the result of the structure the CEC articulates in solicitation documents.

Figure 3: Electric Program Investment Charge Projects With Three or More Stakeholder Group Types (Through December 2020)



This figure does not include CalSEED projects.

Source: California Energy Commission

Coordination With Electric Program Investment Charge Administrators and Other Energy Innovation Efforts

Coordination helps make the CEC EPIC more effective for the California ratepayer by informing work to ensure the CEC portfolio of EPIC projects is strategically focused to advance the most significant technological challenges.

The CEC is committed to ongoing coordination and collaboration with the three investor-owned utility (IOU) administrators of EPIC funds (Pacific Gas and Electric Company [PG&E], Southern California Edison [SCE], and San Diego Gas & Electric Company [SDG&E]) and other energy innovation stakeholders in developing and implementing EPIC Investment Plans.

Electric Program Investment Charge Administrator Coordination

CEC staff collaborated with the three IOU EPIC administrators by conducting biweekly conference calls, coordinating notification and outreach for upcoming events, and participating in joint public workshops. The following activities highlight EPIC administrator coordination for 2020.

- The CEC held two conference calls a month with the IOU EPIC administrators to share best practices in administering the EPIC research program.
- The CEC coordinated with the IOU EPIC administrators and the Policy + Innovation Coordination Group (PICG). The CPUC established the PICG in 2018 to conduct specific coordination functions to ensure that EPIC investments are optimally aligned with and informed by key CPUC and California energy innovation needs and goals. The PICG is dedicated to identifying timely opportunities for substantive feedback and coordination among EPIC investments and California's energy innovation needs and goals. The PICG provides support functions to allow this feedback and coordination to occur effectively. The PICG held a series of webinars during September–December 2020 featuring results of EPIC-funded projects, as well as input from technology developers and stakeholders. Topics included equity, wildfire mitigation, public safety power shutoffs,[3] and transportation electrification (advancing technologies and expanding infrastructure for electric vehicles).
- On October 19–21, 2020, the CEC hosted the 2020 EPIC Symposium in conjunction with the IOU EPIC administrators. Due to the COVID-19 pandemic, the event was held entirely online. More than 900 people attended. Speakers at the symposium shared policy innovations and results from EPIC-funded technologies designed to:
    - Improve the affordability, health, and comfort of California's communities.
    - Build a safer and more resilient electricity system.
    - Support California's local economies and businesses.
    - Advance zero-carbon technologies for homes, businesses, and transportation.
    - Expand the use of renewable energy.
    - Implement a more decentralized electric grid.

3 California investor-owned electric utilities turn off power to specified areas when high winds and related conditions pose a high risk of fire. The CPUC public safety power shutoff web page provides further information.

- The Emerging Technologies Coordinating Council (ETCC) is a collaborative of PG&E, SCE, Southern California Gas, SDG&E, Los Angeles Department of Water and Power, Sacramento Municipal Utility District, and the CEC. The purpose of the ETCC is to expand knowledge of emerging technologies by sharing project results, methodologies, and collaboration opportunities for advanced lighting, water heating, space heating, and air-conditioning systems. In 2020, the ETCC hosted four webinars related to CEC EPIC-funded research.
    - February 26, 2020: The "Demand Response Technology Assessment and Delivery: Accelerating Tech Transfer of California's EPIC Projects" webinar included discussion of CEC EPIC-funded projects on the following topics: smart inverters/smart consumer devices, signals for transactive load management, vehicle grid integration, demand-side resource integration platform, and demand response control strategies.
    - May 13, 2020: The New Buildings Institute, a nonprofit organization advancing energy efficiency in buildings, shared energy-saving results of a CEC-funded project validating performance of an emerging window-shading technology. The project demonstrated impressive energy savings for lighting (60 percent or more in summer) and heating, ventilation, and air conditioning cooling (19 percent or more) in existing businesses.
    - July 22, 2020: At the "IoT, More IoT, and Rapid Modeling for Residential Communities" webinar, Universal Devices, Inc., described the importance of the internet-of-things (IoT) for the smart grid. Universal Devices, Inc., manufactures low-cost home automation and energy management products. The IoT is the use of sensors and software in physical devices, such as window blinds and air conditioners, with the capability to exchange data with other devices. This expands the potential for customers to shift or reduce energy consumption in response to price signals from the California ISO. The presentation included an overview of a CEC EPIC-funded proof of concept pilot of a retail automated transactive energy system.
    - September 24, 2020: At the "Demand Response Technology Assessment and Delivery: Accelerating Tech Transfer of California's EPIC Projects" webinar, the University of California, Davis shared results of a CEC EPIC-funded project to develop and test a programmable logic controller for the timing and duration of operating fans, conductively cooled plastic mats, and spray water. The system was optimized to save water and electricity used to reduce heat stress for dairy cows.

Coordination With the California Public Utilities Commission

In 2020, CEC staff coordination with the CPUC included the following EPIC-related activities:

- Participation in the Policy + Innovation Coordination Group, including planning and participation in 11 public workstream meetings featuring 28 CEC EPIC-funded projects.
- The CEC staff transitioned the Vice Chair's EPIC research site tours to a digital format in response to COVID. The CEC hosted four tours covering a range of projects and technologies across the state, including the Blue Tech Valley Innovation Cluster, the Cleantech San Diego Innovation Cluster, Clean Energy Manufacturing in California, and

Building Decarbonization. Cumulatively, the tours had 23 participating projects, nearly 200 attendees, more than 40 presenters, and CEC and CPUC Commissioners and staff attending.

- The CEC staff participates in monthly coordination meetings with CPUC staff on EPIC administration.
- The CEC staff participates in monthly coordination meetings with the CPUC Microgrid Office staff on EPIC microgrid activities and grants.
- The CEC staff coordinated site visits by CPUC staff to EPIC Microgrid grant awardee sites.
- The CEC staff provided a technical presentation to the CPUC staff on the energy storage awards from the five EPIC energy storage related GFOs that were awarded in 2020.
- The CEC staff met with CPUC staff in November and December to discuss CEC plans for developing the EPIC interim investment plan. Also, CEC staff shared a draft of the interim investment plan with CPUC staff on December 14 and received input on December 21.
- An EPIC-funded grant for Cal-Adapt development supported a series of public workshops, including CPUC staff, on topics of interest to electricity sector climate resilience, including an introduction to climate data and its applications, wildfire projections in a changing climate, and working with data available through Cal-Adapt for advanced analyses.

Other California State Agency Coordination

In 2020, the CEC's Energy Research and Development Division advanced coordination with other state offices on research, demonstration, and deployment activities.

- In 2020, a CEC EPIC-funded microgrid project, the Redwood Coast Airport Renewable Energy Microgrid, informed consideration of tariffs for multicustomer, front-of-the-meter, critical facility microgrids in the CPUC proceeding regarding microgrids under Senate Bill 1339 (Stern, Chapter 566, Statutes of 2018) and Resiliency Strategies.
- On the topic of resilience and safety, CEC staff held frequent meetings throughout 2020 to coordinate with the Governor's Office of Planning and Research, the California Natural Resources Agency, and the Strategic Growth Council to develop an interagency strategy for an anticipated Fifth Climate Change Assessment.[4] Also, CEC staff coordinated with the Strategic Growth Council and the Governor's Office of Planning and Research to align Cal-Adapt research efforts with state agencies' efforts to present EPIC-funded data to guide the state in climate resilience efforts. The Cal-Adapt Web platform supports risk management and planning by providing access to the wealth of climate projections data and interactive visualizations that help utilities, local leaders,

4 Climate change assessments estimate climate change impacts under projected emission scenarios using a set of global climate change models. In many climate change assessments, model outputs are downscaled to estimate projected impacts at a regional scale. California's Fourth Climate Change Assessment was completed in 2018.

and state officials analyze energy sector vulnerabilities to climate change in California and take strategic actions to strengthen resilience.

- Regarding grid decarbonization, CEC staff held frequent meetings throughout 2020 to coordinate with the interagency SB 100 analysis team on technology innovation and deployment scenarios and contributed to the SB 100 joint agency report.
- Regarding transportation, CEC staff coordinated monthly in 2020 with CARB, California Department of Transportation (Caltrans), and GO-Biz to share research, regulatory activities, and strategies to promote deployment of zero-emission transit and rail in California. CEC staff coordinated quarterly with CARB, Caltrans, California Department of Housing and Community Development, University of California Institute of Transportation Studies, and the California State University Transportation Consortium to share updates on transportation research projects. Also, CEC staff coordinated with CARB to share information, strategies, and research ideas for deploying medium- and heavy-duty battery-electric vehicles and supporting electrical infrastructure. CEC staff also participated in the interagency 2019 Vehicle Grid Integration Working Group[5] as part of R.18-12-006 and the Vehicle-to-Grid Alternating Current Interconnection Subgroup as part of R.17-07-007.
- Regarding diversity and equity, CEC staff attended monthly meetings with CARB's California Climate Investments Outreach Liaisons and presented the Empower Innovation platform and updates on EPIC. Also, staff met with CARB's research and development leads and staff from the Strategic Growth Council to discuss collaboration related to the Empower Innovation online networking platform.
- In 2020, CEC EPIC coordination with the Disadvantaged Community Advisory Group (DACAG) included announcements and updates of CEC EPIC-funded energy storage demonstration projects benefitting tribal areas in California, CEC EPIC funding for demonstration projects in disadvantaged and low-income communities, scoping workshops, and funding opportunities. Also, CEC staff met with the DACAG EPIC subcommittee to discuss disadvantaged and low-income community priorities and challenges related to clean energy. CEC staff and advisors regularly attend DACAG meetings to hear concerns and input.

5 The CEC, CPUC, California ISO, and CARB created the Vehicle Grid Integration Working Group in 2019. In CPUC Rulemaking 18-12-006, this working group was asked to address three questions: What VGI use cases can provide value now, and how can that value be captured? What policies need to be changed or adopted to allow additional use cases to be deployed in the future? How does the value of VGI use cases compare to other storage or DER?

Coordination Meetings With the United States Department of Energy

- Staff from CEC and the Advanced Research Projects Agency — Energy (ARPA-E) continued to coordinate and collaborate in 2020. These efforts included sharing perspectives and analysis on emerging technology advancements, identifying market opportunities for technologies within the two agencies' respective portfolios, sharing best practices and lessons learned with respect to program design and administration, and participating as advisory members on each other's projects. Guided by an interagency memorandum of agreement, the CEC and ARPA-E work together to move transformational energy technologies out of the lab and into the market. Common areas of research include energy efficiency, energy storage, transportation, distributed energy resources, and power electronics.
- The United States Department of Energy (U.S. DOE) and U.S. Global Change Research Program provided technical support for scoring a solicitation to develop next-generation downscaled climate projections, analytics to inform electricity sector resilience, and a data platform to simplify access to data and analytics.
- Staff from EPIC supported the U.S. DOE's efforts to educate different states about the latest advancements in energy storage and microgrids. EPIC staff presentations to these states during webinars hosted by U.S. DOE provided an overview of the lessons learned during the EPIC research and the status of current energy storage and microgrid research in California.
- At the request of U.S. DOE, staff served as a peer reviewer for DOE-funded energy storage and microgrid projects and provided the DOE team updates on EPIC-related research of interest to DOE.
- The CEC engaged in discussions with U.S. DOE, other federal agencies, and state agencies to align offshore wind environmental research topics, explore pathways for joint funding and develop partnerships on offshore wind research, including a potential DOE-led funding opportunity announcement (DE-FOA-0002237, titled Offshore Wind Environmental Research and Technology Validation).

Coordination Meetings With the United States Department of Defense

- CEC EPIC awarded two energy storage projects for a total of $8 million in EPIC funds and $11 million in U.S. Department of Defense match funding to demonstrate increased resiliency and reliability support for critical military facilities and missions at U.S. Marine Corps Base Camp Pendleton.
- The CEC continued to implement the partnership with the U.S. Department of Navy leaders in California, including coordination of critical research projects with the Navy and Marines. The CEC hosted one in-person working group meeting among the Commander of the Navy Facilities Command Southwest, the Commander of the Marine Instillations West, the CEC Chair and a CEC Commissioner, a CPUC Commissioner, the California Independent System Operator (California ISO) CEO, and the Chair of the Governor's Military Council. Staff from the CEC, U.S. Department of the Navy, CPUC, and California ISO held monthly meetings to work on action items assigned by the working group principles.
- In response to the heat waves in summer 2020, the Navy and Marines were able to not only encourage all their members to reduce their own electrical loads (California has the largest concentration of assigned Navy military personnel in the world), but they were

able to temporarily remove more than 20 Navy ships from shore power and operate those ships on internal power, reducing more than 16 megawatts of electrical load. This action would not have been possible if not for the long-term partnership the CEC has maintained with the Navy and Marines in California.

Coordination With Local Governments and Other States

- CEC staff participated in a Rocky Mountain Institute-funded Electricity Innovation Lab Accelerator with the City of Berkeley to design a building electrification pilot project and to explore more broadly how to electrify California's buildings and decommission natural gas infrastructure in a strategic and equitable manner.
- CEC staff coordinated with the Oregon Global Warming Commission on analyses of building electrification and renewable gas to meet midcentury greenhouse gas goals.
- CEC staff is cochairing an American Geophysical Union conference session with New York State Energy Research and Development Authority (NYSERDA) on "Science Informing Energy Resilience and Adaptation Strategies."
- CEC staff participated in interagency technical presentations about respective offshore wind portfolio and research efforts. The exchange of information led to follow-up discussions, including participation of NYSERDA staff in kick-off meetings of new CEC research projects and 2020 research workshops.
- Staff from NYSERDA and staff from the CEC's Clean Transportation Program and EPIC met to discuss each organization's efforts supporting medium- and heavy-duty electric vehicle charging and research and development opportunities.

Transparent Public Process and Competitive Solicitations

The CEC has a robust outreach strategy to shape research through public workshops on investment planning and solicitations. Components of the CEC outreach strategy include:

- Preapplication workshops and requests for comment.
- Increasing diversity and equity in EPIC.
- Sharing knowledge and lessons learned.
- Geographic diversity to accelerate technological learning and technology diffusion.
- Informing policies, proceedings, codes, standards, and protocols.

In 2020, more than 280 public workshops and webinars in 2020 featured CEC EPIC Projects, including events held by CEC EPIC-funded innovation clusters (Table 4).

Table 4: Public Workshops and Webinars With California Energy Commission Electric Program Investment Charge Projects in 2020

Type of Workshop or Webinar	Number of Public Workshops and Webinars With CEC EPIC Projects in 2020
Knowledge sharing	168
Networking	53
Outreach and community engagement	25
EPIC Administrator coordination	16
Coordination with local, state, and federal agencies	7
Scoping of research roadmaps or draft solicitations	9
Preapplication workshops	11
Total	289

Source: California Energy Commission

Preapplication Workshops and Requests for Comment

CEC staff holds preapplication workshops for all solicitations to discuss solicitation purpose and scope in a public forum with potential applicants. These workshops provide an opportunity for potential applicants to ask questions and network. All questions and answers are posted online following the preapplication workshop. The following preapplication workshops were held in 2020:

- January 7, 2020: Preapplication Workshop, GFO-19-305 — Developing Non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals.
- January 17, 2020: Preapplication Workshop, GFO-19-306 — Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies. This solicitation included up to $4 million for longer-duration energy storage to support Native American tribal communities and up to $4 million for longer-duration energy storage to support to low-income or disadvantaged communities.
- January 30, 2020: Preapplication Workshop, GFO-19-307 — Advancing Envelope Technologies for Single-Family Residential Buildings, Low-Rise Multifamily Buildings, and Mobile Homes. This solicitation included up to $6 million for demonstration projects in disadvantaged or low-income communities.
- February 10, 2020: Preapplication Workshop, GFO-19-308 — Assessing Long-Duration Energy Storage Deployment Scenarios to Meet California's Energy Goals.
- February 13, 2020: Preapplication Workshop, GFO-19-310 — Validating Capability of Second-Life Batteries to Cost-Effectively Integrate Solar Power for Small-Medium Commercial Building Applications.
- June 18, 2020: Preapplication Workshop, GFO-19-311 — Climate Scenarios and Analytics to Support Electricity Sector Vulnerability Assessment and Resilient Planning.

- July 30, 2020: Preapplication Workshop, GFO-20-301 — Bringing Rapid Innovation Development to Green Energy (BRIDGE) 2020. This solicitation included up to $16 million for demonstration projects in disadvantaged or low-income communities.
- July 30, 2020: Preapplication Workshop, GFO-20-302 — Realizing Accelerated Manufacturing and Production for Clean Energy Technologies (RAMP) 2020.
- August 5, 2020: Preapplication Workshop, GFO-20-303 — Advanced Plug Load and Smart Exterior Lighting Systems. This solicitation included up to $6 million for demonstration projects in disadvantaged or low-income communities.
- September 22, 2020: Preapplication workshop, GFO-19-309 — California Flexible Load Research and Deployment Hub.
- October 14, 2020: Preapplication Workshop, GFO 20-304 —Evaluating Bidirectional Energy Transfers and Distributed Energy Resource Integration for Medium- and Heavy-Duty Fleet Electrification. For this solicitation, each proposal had to include at least one demonstration/deployment site located in a disadvantaged community per CalEnviroScreen 3.0.

In some cases, CEC staff holds public workshops to solicit input on research roadmap development, research scenario development, or draft competitive solicitations. In 2020, CEC staff held the following research scoping public workshops:

- Draft solicitation concept for "The Next EPIC Challenge: Reimagining Affordable Mixed-Use Development in a Carbon-Constrained Future."
    - February 26, 2020: Staff scoping workshop on this topic held in Los Angeles.
    - February 27, 2020: Staff scoping workshop on this topic held in San Diego.
    - March 27, 2020: Staff scoping webinar held on this topic.
    - April 21, 2020: Staff scoping webinar held on this topic.
    - July 13, 2020: This topic was featured in a German-American Chamber of Commerce Information Session.
- February 26, 2020: Staff presolicitation meeting to seek input on concepts for the Reliable Electric Mobility Infrastructure solicitation.
- April 10, 2020: Staff scoping webinar held on draft solicitation concept for zero-emission transit fleet infrastructure deployment.
- October 22, 2020: Staff scoping workshop was held on a draft solicitation concept to advance to next-generation offshore wind energy technology.
- December 3, 2020: Staff workshop was held to receive public comments to inform research for two recently funded EPIC grants assessing the role of energy storage and long-duration energy storage in meeting California's future clean energy goals.

Increasing Diversity and Equity in the Electric Program Investment Charge

California's promise, successes, and innovation stem from the rich and diverse qualities and abilities of its people. The CEC is committed to:

- Hosting outreach events that inform small businesses, and women-, disabled veteran-, minority-, and lesbian, gay, bisexual, transgender, queer- (LGBTQ) owned businesses, and economically disadvantaged communities about opportunities to participate in program solicitations and activities.

- Enhancing efforts to reduce barriers preventing low-income, disadvantaged, and tribal communities from accessing clean energy opportunities.

Diverse Business Ownership

The CEC encourages women-owned, minority, disabled veteran, and LGBTQ businesses to apply for CEC funding. In April 2015, the CEC adopted a resolution outlining its commitment to ensure that all Californians have an opportunity to participate in and benefit from CEC programs that lead to job creation and training, improved air quality, and energy efficiency and environmental gains.[6]

In October 2015, Assembly Bill 865 (Alejo, Chapter 583, Statutes of 2015) required the CEC to "develop and implement an outreach program to inform the most qualified loan and grant applicants, and contractors, including, but not limited to, women, minority, disabled veteran, and LGBT [lesbian, gay, bisexual, and transgender] business enterprises, about workshops, trainings, and funding opportunities. The purpose of the program is to ensure that the commission recognizes the demographic shifts of the California marketplace and is nurturing the new and next generation of energy technology leaders."[7]

The CEC funded development of Empower Innovation, a professional networking platform that helps everyone, including local governments, community-based organizations, small businesses, and cleantech start-ups, identify funding and partnering opportunities to advance a clean energy future for all. Empower Innovation supports outreach efforts to enhance the inclusivity of CEC programs by cultivating a diverse network of stakeholders and curating valuable resources for advancing clean technologies.

A "Certified" business enterprise is one that is certified by the Public Utilities Commission, the Department of General Services, or other nonprofit organizations that verify or certify women, minority, disabled veteran, and LGBT business enterprises. The following websites are available to learn whether a business is certified: the California Public Utility Commission Supplier Clearinghouse lists certified women, minority, disabled veterans, and LGBT business enterprises. The California Department of General Services lists certified small and disabled veteran business enterprises.

CEC staff has been using a voluntary survey of research workshop participants to inform outreach. For 2015–2020, these self-reported data show that more than 12 percent of research workshop participant survey respondents stated their company identified as one or more of the following: disabled veteran business enterprise, women-owned business, minority-owned business, or LGBT-owned business. In addition, more than 20 percent of survey respondents stated their company was a small business, and more than 80 percent stated their company was in California. The data for disabled veteran-owned businesses include data reported to the CEC separately for EPIC contracts. Data for the prime recipient for each agreement are included in Appendix C.

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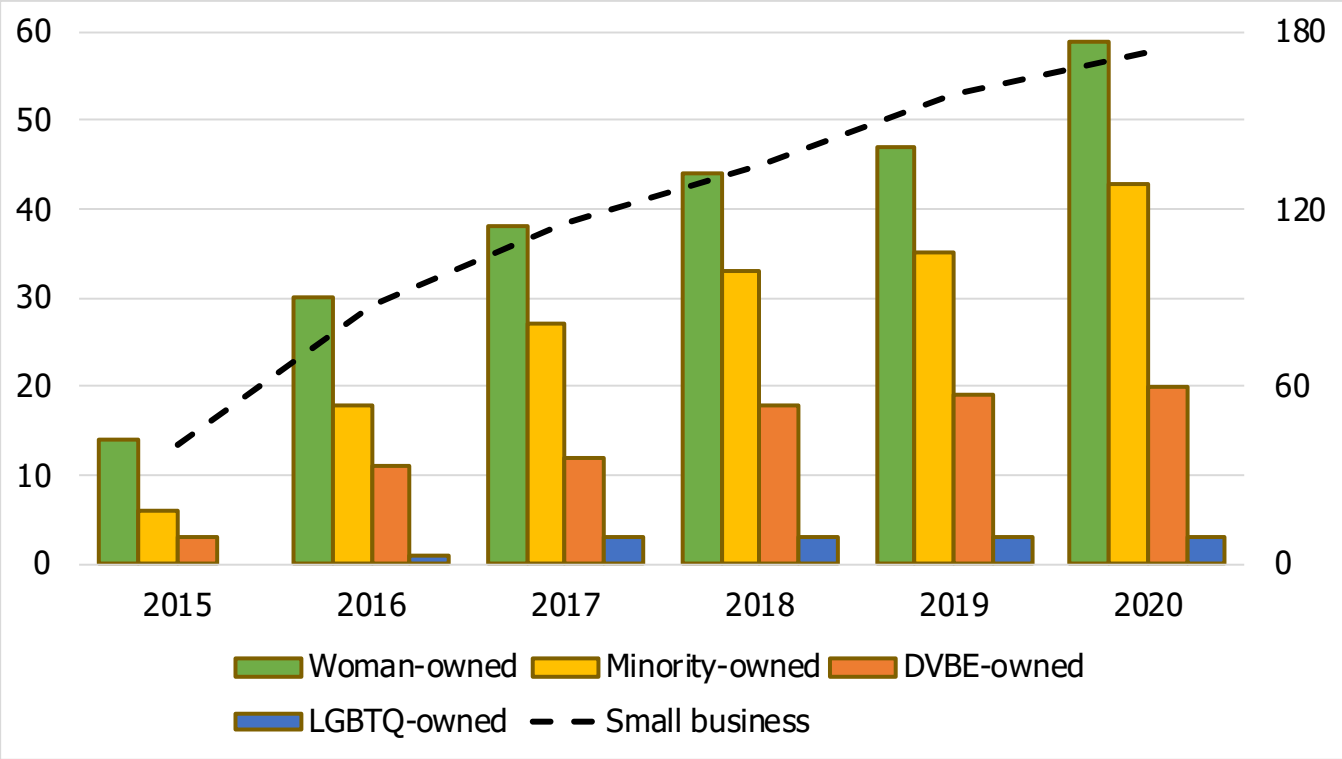
6 CEC, April 8, 2015, Resolution 15-0408-3: Resolution Regarding Diversity Policy Statement. https://www.energy.ca.gov/commission/diversity/documents/pdfs/diversity_policy_resolution.pdf.

7 See Public Resources Code Section 25230(b)(1).

Figure 4: shows EPIC agreements reporting one or more of the following as a prime or subcontractor:

- Small business
- Women-owned business
- Minority-owned business
- Disabled veteran-owned business
- LGBTQ-owned business

Figure 4: Electric Program Investment Charge Awardee Business Ownership, Size, and Location (Prime and Subcontractors) 2015 Through 2020 by Agreement



Self-reported survey data for EPIC agreements with one or more entities (prime or subcontractors) in each of the listed categories. The numbers of agreements reporting one or more small businesses are shown on the right axis. The numbers of agreements reporting one or more women-owned, minority-owned, DVBE-owned and LGTBQ-owned businesses are shown on the left axis.

Source: California Energy Commission

Energy and Equity: Assembly Bill 523 Implementation

The CEC is committed to ensuring all Californians benefit from clean energy research. The CEC, consistent with legislative and CPUC direction, has prioritized energy equity in its research programs to ensure that the most vulnerable communities benefit from emerging

clean energy technologies.[8] The CEC's EPIC exceeded the requirements set forth in Assembly Bill 523 (Reyes, Chapter 551, Statutes of 2017) for at least 25 percent of the technology demonstration and deployment funds to be spent on projects in and benefitting disadvantaged communities. Also, AB 523 requires an additional 10 percent of the technology demonstration and deployment funds to be spent on projects in and benefitting low-income communities.[9] Through 2020, 65 percent of EPIC demonstration funding has been allocated to projects that meet the requirements of AB 523. Including additional projects benefitting California Native American tribes brings the total to 68 percent.

Figure 5 shows the CEC EPIC project sites located in disadvantaged communities — as defined in Section 39711 of the California Health and Safety Code and the California Environmental Protection Agency based on census tracts with the top 25 percent scores from CalEnviroScreen — and a separate marker for project sites that are low income but not disadvantaged. These data are through December 2020.

Most of California's disadvantaged communities are also low-income communities; to avoid double counting, such communities are included in the disadvantaged community category.

In 2020, the CEC expanded the use of scoring criteria in EPIC technology demonstration and deployment solicitations that ensure each project in a disadvantaged or low-income area is providing direct benefits to the local community. The scoring criteria evaluate technology demonstration and deployment proposals on benefits to disadvantaged or low-income communities, community engagement efforts, and localized health impacts. In addition, the CEC will continue to set aside funding in applicable EPIC solicitations for projects in and benefitting disadvantaged or low-income communities or both.

Also, beginning in 2020, proposed EPIC demonstration projects in low-income or disadvantaged communities must allocate appropriate funding for community-based organization participation in relevant tasks under the scope of work.[10] Examples include facilitating project and community meetings, obtaining community input through surveys and

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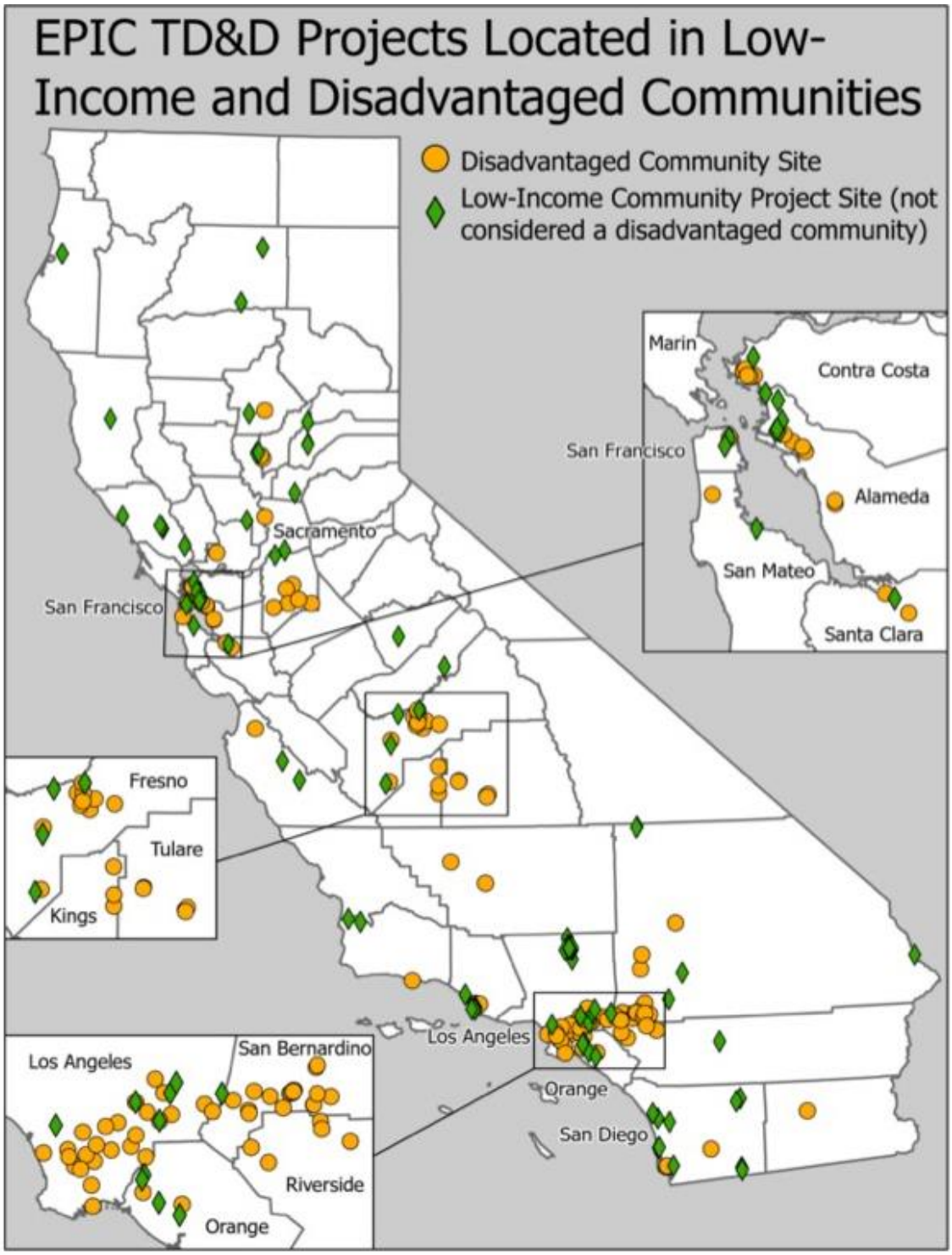
8 In 2015, the Energy Commission adopted a diversity policy resolution outlining its commitment to ensure all Californians have an opportunity to participate in and benefit from CEC programs. https://www.energy.ca.gov/commission/diversity/documents/pdfs/diversity_policy_resolution.pdf. In 2016, the CEC's Low-Income Barriers Study recommended the CEC's EPIC program should target a minimum of 25 percent of technology demonstration and deployment funding for sites located in disadvantaged communities. See https://www.energy.ca.gov/sb350/barriers_report/.

9 *Disadvantaged communities* are those designated under to Health and Safety Code Section 39711 as representing the 25 percent highest-scoring census tracts in California Communities Environmental Health Screening (CalEnviroScreen) Tool 3.0. https://calepa.ca.gov/envjustice/ghginvest/. *Low-income communities* are those within census tracts with median household incomes at or below 80 percent of the statewide median income or the applicable low-income threshold listed in the state income limits updated by the California Department of Housing and Community Development (HCD).

10 Community-based organizations should meet, and will be evaluated on, the following criteria for EPIC solicitations: 1) has an office in the region (e.g., air basin or county) and meets the demographic profile of the communities they serve; 2) has deployed projects and/or outreach efforts within the region (e.g., air basin or county) of the proposed disadvantaged or low-income community; 3) has official mission and vision statements that expressly identifies serving disadvantaged and/or low-income communities; 4) currently employs staff member(s) who specialized in and are dedicated to diversity, or equity, or inclusion, or is a 501(c)(3) nonprofit.

focus groups, developing communication materials in languages used locally, participating on technical advisory committees, and consulting on project siting and coordination.

Figure 5: Electric Program Investment Charge Project Sites in Assembly Bill 523 Priority Communities



Source: California Energy Commission

From September 2019 through August 2020, the Energy Research and Development Division (ERDD) Market Facilitation Unit hosted a CivicSpark fellow. CivicSpark is an AmeriCorps program dedicated to building capacity for local public agencies to address community

resilience issues such as climate change, water resource management, housing, and mobility. The goal of the fellow's service year was to help further the connection between the CEC's research programs and the energy policy goals of the local governments and disadvantaged communities. Throughout the year, the CivicSpark fellow worked directly with two local governments in disadvantaged communities, the cities of Paramount (Los Angeles County) and Arvin (Kern County), to identify barriers to accessing renewable energy. The fellow also worked closely with the ERDD team to increase the number of environmental justice organizations, disadvantaged communities, and local governments represented on Empower Innovation.net, as well as added relevant resources, funding opportunities, and events to make the platform more useful to diverse communities.

Additional work completed by the CivicSpark fellow related to Empower Innovation included the following:

- Led local government outreach for the CEC's clean tech networking platform, EmpowerInnovation.net.
- Maintained a database of events, funding opportunities, and resources for local governments, disadvantaged and low-income communities, and tribes.
- Set up meetings with strategic local government partners to provide a platform demonstration and discuss further partnership opportunities, such as advertising Empower Innovation in its newsletters or hosting a webinar for its members.
- Organizations engaged include the Local Government Commission, the Institute for Local Government, the Foundation for Community Colleges, the Sierra Business Council, Liberty Hill, East Yard Communities, the Greenlining Institute, the Local Government Sustainable Energy Coalition, and the California Climate Investments Outreach Liaisons group.
- Organized an Empower Innovation webinar for local governments with the Local Government Sustainable Energy Coalition. More than 300 individuals registered for the webinar, and more than 160 unique viewers attended the webinar.
- Recruited the Institute for Local Government to be an affiliate partner for the platform.
- Created shell profiles for the 10 disadvantaged and low-income communities that are part of the Institute for Local Government's BOOST program.

Additional Outreach Efforts

Additional outreach efforts to tribal, low-income, and disadvantaged communities in 2020 include the following:

- As part of the EPIC Symposium, the CEC organized two "Community Talk Sessions." One included a tribal focus that featured moderated and interactive roundtable discussions with local leaders working to bring clean energy solutions to their communities. Speakers shared first-hand insights into the various challenges these communities face, what their priorities are, and what types of technology solutions interest them.
- On September 2-3, the CEC sponsored the "EPIC Forum: Reimagining Buildings for a Carbon-Neutral Future. The forum included a "Lightning Talk" session, "Welcome to My Neighborhood," providing the opportunity for community leaders to discuss priorities as they relate to the decarbonization of buildings (reducing carbon emissions from buildings and sources of heat energy to zero) in their communities.

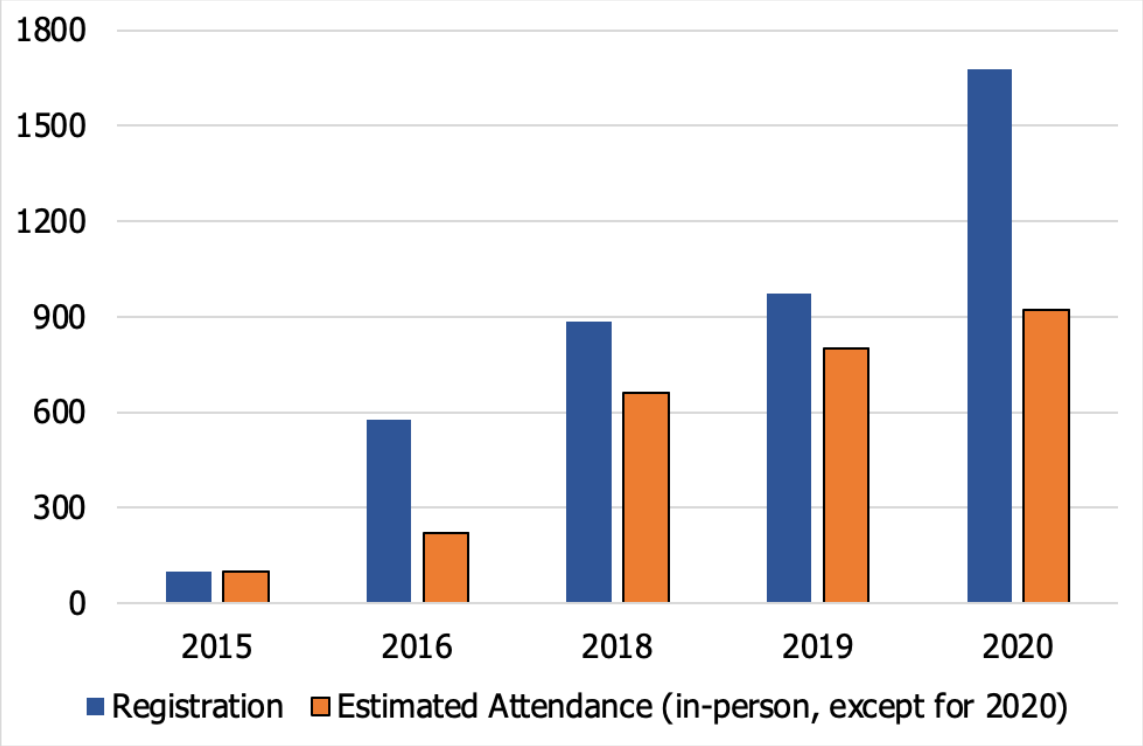
- On January 22, the CEC conducted a tribal webinar to demonstrate the Empower Innovation platform and assist tribes interested in joining the platform.
- ERDD participated in the Environmental Justice Roundtable led by Chair David Hochschild, Vice Chair Janea Scott, and Public Advisor Noemí Gallardo as an opportunity to hear from environmental justice leaders and share relevant program updates.
- The Oakland Ecoblock, a project funded by EPIC, identified a new project site by undergoing a successful "self-elect" campaign that leveraged the support of community leaders and city council members. Communities could apply to participate in the project with the support of residents. The resulting project site has full participation from residents on the block and is within a disadvantaged community.
- The Basset Avocado Advanced Energy Community, a project funded by EPIC, established a community advisory committee with more than 10 community members representing local businesses, homeowner associations, the school district, and other community members. To encourage community participation, the project also plans to develop a large social media presence, public meetings, focus groups, phone banking, and outreach through local media outlets.
- Researchers at the University of California, Irvine, developed a community end-use survey that will be used in a disadvantaged community to tune their microgrid model. This project received EPIC funding. The model improvements will allow microgrid design that improves urban air quality, reduces greenhouse gas emissions, support grid operations, and improves community resiliency to adverse events. In early 2021, researchers plan to send the survey to the Oak View Community of Huntington Beach, which is a disadvantaged community as defined by SB 535 and CalEnviroScreen.
- Researchers at EPRI, in coordination with their partners LINC Housing and OhmConnect, have started recruiting 61 tenants in a disadvantaged community in the Los Angeles Basin onto the OhmConnect's Demand Response platform. This EPIC-funded project is finalizing a communication plan on informing the tenants about the program signup process. The team anticipates completing the onboarding process in early 2021 and conducting the program from April 2021 through March 2022.
- With CEC EPIC funding as cost share for a federal grant, researchers at SCE, in partnership with the U.S. DOE and Kitu Systems, have begun customer acquisition efforts to enlist up to 100 households and businesses in a low-income and disadvantaged community in Santa Ana onto the Electric Access System Enhancement (EASE) pilot program. The EASE pilot will provide financial support for residents to install behind-the-meter solar and storage and cluster these systems through distributed controls to streamline interconnection and expand circuit hosting capacity. SCE and Kitu Systems will begin interconnecting customers under the EASE program in early 2021.
- Please see the coordination section for information on CEC EPIC coordination with the DACAG.

Sharing Knowledge and Lessons Learned

The CEC's EPIC shares knowledge and lessons learned among technology innovators, technology adopters, architectural and engineering firms, start-up services, funding providers, and local communities. This sharing is an important method for scientific and technological diffusion and accelerates uptake of scientific and technological achievements. Results are shared through multiple pathways. For example:

- Figure 6 shows that participation in EPIC symposiums hosted by the CEC continued to increase in 2020. With the exception of 2017, the CEC has hosted a symposium each year in coordination with the three IOU EPIC administrators.[11] The symposium brings together policy leaders, technology adopters, entrepreneurs, and others to discuss clean energy research, results, and challenges (Figure 6 and Figure 7).
- The CEC shares EPIC project results online through the CEC Energy Innovation Showcase.
- The CEC posts a final report online for each EPIC project. Table 15: Published Final Reports for CEC EPIC-Funded Projects Completed in 2020 in Chapter 3 lists all projects completed in 2020 and provides links to published final reports.
- Researchers use and cite academic publications to learn and build upon recent advancements.

Figure 6: CEC-Hosted Electric Program Investment Charge Symposium Trends



Source: California Energy Commission

11 On October 18, 2017, CEC staff joined the IOUs for the 2017 EPIC Fall Symposium in La Jolla (San Diego County) hosted by SDG&E. This public symposium provided an overview of EPIC program activities and showcased EPIC projects that support distribution system automation.

Figure 7: Knowledge Sharing at the 2020 Electric Program Investment Charge Virtual Symposium

From top to bottom, starting top left: Governor Gavin Newsom, Chair David Hochschild, Vice Chair Janea Scott, Commissioner Andrew McAllister, David Nemtzow (Director of Building Technologies, U.S. Department of Energy), California State Senator Nancy Skinner, California State Senator Bob Wieckowski, California State Assemblymember Autumn Burke, Julia Pyper (Political Climate Podcast), California State Assemblymember Cristina Garcia.

Source: California Energy Commission

Online tools and resources also help share knowledge generated through the CEC EPIC. Table 5 illustrates uptake of a sample of EPIC-funded tools and resources available online and several tools coming soon. These tools can help utilities, decision makers, innovators, and other stakeholders strengthen resilience, safety, and affordability. For example, the Cal-Adapt web platform supports risk management and planning by providing access to the wealth of climate projections data and interactive visualizations that help utilities, local leaders, and state officials analyze energy sector vulnerabilities to climate change in California and take strategic actions to strengthen resilience.

Table 5: Selected Online Tools and Resources by Electric Program Investment Charge Investment Topic

Investment Topic	Online Tools and Resources and Use in 2020
Entrepreneurial Ecosystem	• Empower Innovation (1,850+ users; 190,390+ views) https://www.empowerinnovation.net/. Access to funding and networking opportunities for clean energy in California. • Founders Playbook (3,150+ users, 4,340+ views): http://playbooks.cyclotronroad.org/. A curated library of essential reading and example materials related to launching and growing a hardware-focused clean energy company. • Activate Toolkit (250+ users, 1,000+ views): https://www.activate.org/learn. A set of training materials and curricula for science innovation and hard technology entrepreneurs to address knowledge gaps in the ecosystem. Resources include a Science Innovators Handbook and video series, which guide the exploration of commercial applications for research discoveries, as well as a series of webinars, community events and instructional videos. • Empower Procurement (1,000+ users; 7,100+ page views) https://empowerprocurement.com/. Informs on the Empower Procurement Program, procurement initiatives, partners, and how to get involved. Provides access to resources like the Product Evaluation Hub, registration for Selling Sustainability Series events, libraries of past events, and certain materials or presentations developed for PIs.
Resilience and Safety	• Cal-Adapt (22,000+ users and 109,000+ views in 2020): https://cal-adapt.org/. Climate change data and visualization tools. • Pyregence (6,050+ users, 17,285+ views): https://pyregence.org/. Wildfire data, forecasts, and scenarios to inform operation and planning for a safe, reliable, and resilient electric grid. This project includes a user engagement team and four working groups focused on the development of near- and long-term wildfire risk models and advances in wildfire modeling regarding extreme weather and wind events, the effects of widespread tree mortality, the dynamics of vegetation/fuel with climate change, and fire behavior in the wildland-urban interface.

Investment Topic	Online Tools and Resources and Use in 2020
Building Decarbonization	• Integration of CaRM Model G –functions to USDOE's EnergyPlus Platform to simulate Ground Sourced Heat Pumps (The USDOE EnergyPlus building simulation program has an average of 43,000 downloads for each update) https://energyplus.net/. The heat exchanger response g-functions (functions to calculate ground loop heat exchanger response to square heat pulses depending on the duration of the pulses) developed using the CaRM model were applied in EnergyPlus to simulate building energy consumption when using a ground-source heat pump coupled to the large-diameter shallow-bore GHE. • WISE (9,700 users; new web site coming soon). High-performance building resources and training. • OhmConnect (750,000 signups through December 2020; EPIC project helped grow signups from 15,000 to 500,000 between March 2016 and March 2019): https://www.ohmconnect.com/. More than 50,000 user devices — primarily smart plugs and smart thermostats — are connected to the OhmConnect platform for automatic control. During the summer heat wave of 2020, OhmConnect customers provided about 1 GWh of energy and 100 MW of peak capacity across more than 150,000 active users. OhmConnect coordinates time-dependent energy-use reduction and energy savings across a large group of ratepayers. • Dr. Power (3,175+ users): https://corp.hea.com/dr-power. Advances energy efficiency by allowing residents to identify home appliances that use energy even when turned off. • Manage Your Power (950+ users; 1,900 views): https://manage-your-power.com/. Convenient way for businesses to connect with qualified service providers to upgrade facilities or identify energy-saving opportunities. • OpenBuildingControl: https://obc.lbl.gov. This online tool improves the design process of the control sequences used in commercial buildings. This LBNL tool provides cost-effective implementation, and validation and was co-funded by the California Energy Commission and the Department of Energy (DOE). • Commercial Building Energy Saver (CBES) (2,000+ users; 8,000+ page views): http://cbes.lbl.gov/. This web-based tool enables building owners, facility managers, etc. to identify and evaluate technologies that improve the energy efficiency of small/medium-sized office and retail buildings. • Smart Ceiling Fans: (1,200 views, 685 downloads): https://cbe.berkeley.edu/?s=fans. This project demonstrated energy savings and improved comfort through the integration of smart ceiling fans and smart thermostats in retrofit applications. https://cbe.berkeley.edu/research/advanced-ceiling-fan-design-tool/. This free interactive tool allows designers to quickly select and layout ceiling fans in a room to meet the desired airspeed requirements, and to facilitate incorporation of fans into designs.

Grid Decarbonization and Decentralization	• Powernet (11 users for pilot-scale deployment): https://powernet.stanford.edu/. Pilot-scale system for participating residents to buy and sell local energy generation and time-dependent local reduction in energy use. • StorageVET® 2.1 (Code downloads: 201 from 53 organizations; User Guide downloads: 574 from 116 organizations; and Site views: 2,385 from 316 organizations): https://www.storagevet.com/home/. StorageVET® 2.1 is a modeling tool that facilitates the understanding of where to place and install energy storage, the optimum size as well as controls options. StorageVET® 2.1 implements dispatch optimization with sensitivity analysis to assist in planning energy storage project development by enabling rapid analysis of scenarios with different storage sizes, costs, and value streams. Moreover, StorageVET® 2.1 is valuable as a research tool to inform analyses of trends in storage value as a function of location, operation, and technical capabilities. • E3 Solar + Storage Modeling Tool (77 downloads): https://willdan.app.box.com/s/t3x5xv9r20im78pua5nvbfzbl9p74pmm. The tool estimates the value of integrated solar and storage systems based on the expected optimal operations, location on the grid, market prices, and other characteristics. It also evaluates the operation of distributed solar and storage in combination with other DER technologies such as smart thermostats, electric vehicle chargers, and similar devices. • GridLAB-D optimization (EPIC-funded upgrades coming soon): https://github.com/gridlab-d/gridlab-d. Building on the existing GridLAB-D open-source software, EPIC-funded development of a user-friendly interface for distribution grid modeling, model manager and converter, and optimization of the GridLAB-D computation engine to improve the performance for very large-scale simulation studies, such as studies to address distribution planning questions for renewable integration, energy storage, and demand response. GridLAB-D has been downloaded more than 100,949 times. • DER Outstation (EPIC-funded upgrade): https://github.com/epri-dev/der-dnp3-an2018. The Distributed Energy Resource (DER) Outstation 2018 is a lightweight, portable, fast, and tested implementation of the IEEE 1815 standard or Distributed Network Protocol's (DNP3) Application Note AN2018-001 for interoperable grid communications with DERs. The DER Outstation simplifies the process of adding the standard to devices by providing developers with a simple interface that they can connect to their software. • DER-VET™ (Beta test user code downloads: 200+ from 51 organizations; user guide downloads: 460+ from 94 organizations; site views: 1,360+ from 200 organizations; and full tool release date: March 31, 2021): www.der-vet.com. DER-VET™ is a modeling tool that provides a platform for the calculation and understanding of the optimal sizing and value of energy storage, other distributed energy resources (DER), and microgrids based on the technical merits and constraints.

Investment Topic	Online Tools and Resources and Use in 2020
Grid Decarbonization and Decentralization (continued)	• iDERMS (39,310+ site views, 120+ users) https://intra.ece.ucr.edu/~nyu/iDERMS.html. EPIC funded the development of integrated distributed energy resources management system (iDERMS). iDERMS™ is a distributed energy resource and distribution network management tools that covers normal and abnormal operation conditions. iDERMS™ provides three key modules: three-phase optimal power flow, data-driven Volt-VAR control, and network reconfiguration. These modules work together to improve the dispatch of distributed energy resources and enhance the operation of voltage regulating devices and remotely controllable switches. • Clean Power Research. Simulated 15-Minute Interval Data of CSI Data: https://www.californiadgstats.ca.gov/downloads/#_csi_15_id. Simulated dataset that was built on measured historical production data for 414 of 504 systems that were monitored under the California Solar Initiative (CSI) from January 1, 2011 through December 31, 2016 that contains solar PV production data by zip code at 15-minute intervals. This is a completed and continuous dataset, with gaps in the measured data and invalid data that were filled and replaced with simulated data reflecting the characteristics of the underlying systems.
Industrial and Agricultural Innovation	• Accelerating Drought Resilience (1,050+ users, 2,820+ views): https://droughtresilience.com/. Insights and resources from water and wastewater technology providers and adopters in Tulare County. • Waste-to-Energy Matching and Biositing Tool: https://biositing.jbei.org/. Shows available biomass within a user-specified distance from a potential biomass facility. • In-Conduit Hydropower Business Case Assessment Tool: https://www.energy.ca.gov/programs-and-topics/topics/research-and-development/research-tools. The tool allows operators and managers to easily evaluate the technical and economic feasibility of proposed in-conduit hydropower projects by assessing the hydropower potential at specific sites; recommending suitable in-conduit hydropower technologies; estimating preliminary life-cycle capital and operations and maintenance costs; and determining potential greenhouse gas emissions. • Deep Sea Annotation Tool (prototype): https://github.com/video-annotation-project. This prototype demonstrates that automated classification of ocean species from video is possible. With further development, this could lower the cost of underwater biological surveys for offshore renewable energy.

Investment Topic	Online Tools and Resources and Use in 2020
Transportation Electrification	• MyFleetBuy (10,705 vehicles): https://mygreencar.com/fleet/. Web portal for consulting services to compare costs, fueling, and return-on-investment for fossil-fuel, hybrid, and electric vehicles to inform ground transportation fleet procurement and operation. • Smart Charging Infrastructure Planning Tool (SCRIPT) (8 users) proposes and implements a daily predictive smart charging strategy that foresees the future travel needs of drivers and grid conditions. The tool also studies the role of different charging infrastructure investment strategies in the effectiveness of EV smart charging techniques to accommodate California renewable penetration goals. SCRIPT is publicly downloadable with instructions at https://github.com/slacgismo/SCRIPT.

Online tools and resources include databases, visualization tools, and research roadmaps.

Source: California Energy Commission

Other examples of knowledge sharing activities include the following:

- The CEC held two technology forums in 2020 and has plans under way to host additional technology forums in 2021. The CEC held the first technology forum in Long Beach (Los Angeles County) in February. The forum highlighted new clean energy technologies that can help improve the resiliency of California's electricity sector to climate change impacts and extreme weather events. The second technology forum was held online in September. The forum highlighted innovative new clean energy technologies that can help reimagine new and existing building development to achieve carbon neutrality in the electricity sector by 2045.
- Regarding grid decarbonization and decentralization, the improvement in the short-term load forecasting method conducted by researchers at Clean Power Research, LLC was shared with the California ISO, which provided feedback on the project as a member of the technical advisory committee. The California ISO is analyzing the resulting model alongside other modeling methods to ensure forecast accuracy and quality.

Geographic Diversity to Accelerate Technological Learning and Technology Diffusion

Successful emergence and diffusion of clean energy innovations from lab to market require technological learning and feedback from local installers, workers, early adopters, inspectors, and regulators. Technological learning happens primarily through the technology demonstration and deployment program area, when new technologies are tested in the real world under careful observation, measurement, and verification of performance.

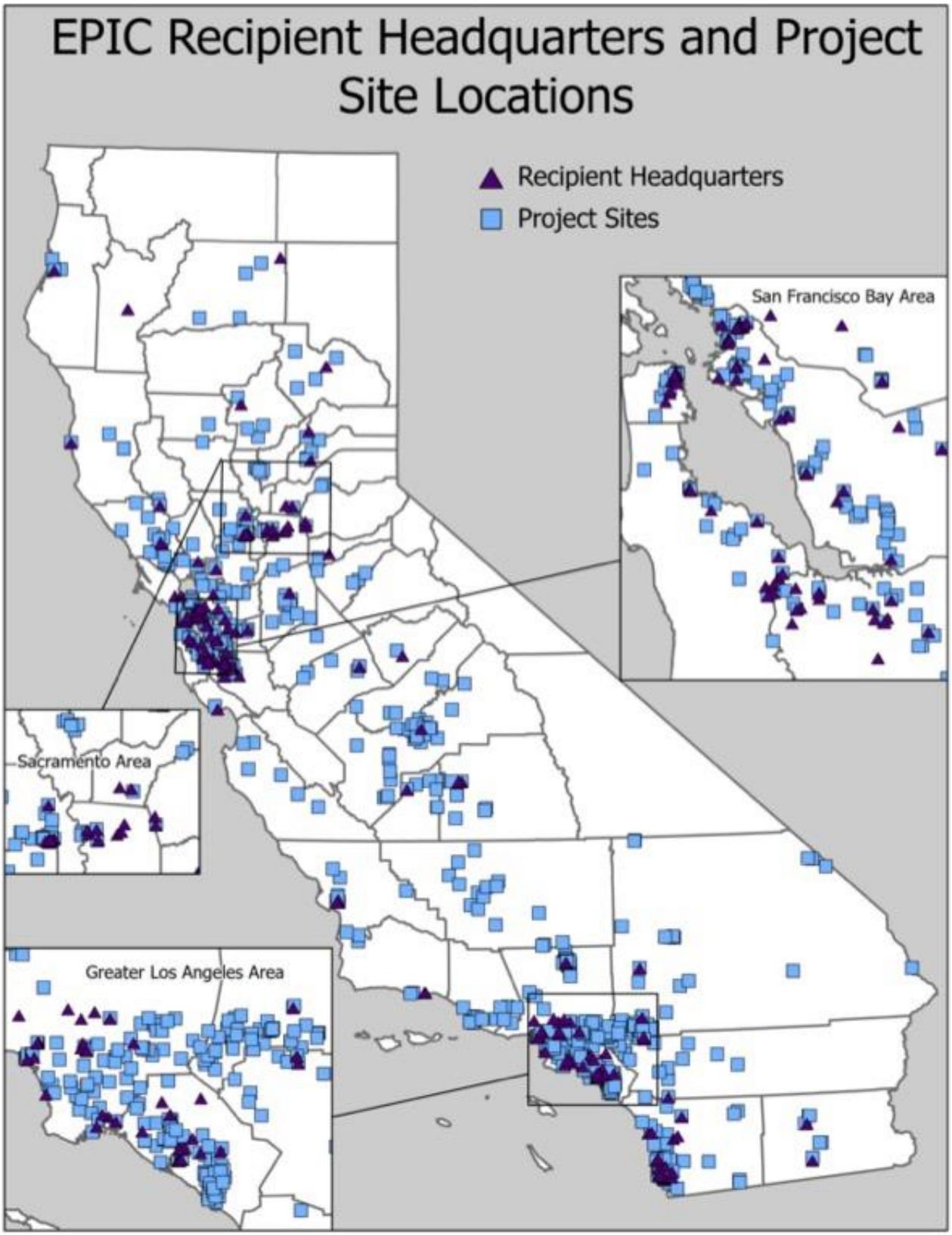
Figure 8 shows CEC EPIC awardee headquarters and project sites across California. This map includes active and completed CEC EPIC awards through 2020 for applied research and development, technology demonstration and deployment, and market facilitation projects. EPIC-funded technology demonstration and deployment projects are limited to California investor-owned electric utility service territories.

Informing Policies, Proceedings, Codes, Standards, and Protocols

EPIC research funded through the CEC has been instrumental in informing state policy and developing and demonstrating technologies on critical topics to further California's progress in meeting its clean energy mandates. The CEC informs state policy through scientific research and by the collective learning from technology research projects. Table 6 lists selected improvements in codes, standards, and protocols advanced by EPIC project results.[12]

12 For additional information, see California Energy Commission, April 17, 2020. Opening Brief of the California Energy Commission to the Phase 1 Issues Identified in the Assigned Commissioner's Scoping Memo and Ruling. CPUC Rulemaking 19-10-005.

Figure 8: Electric Program Investment Charge Recipient Headquarters and Project Site Locations



Source: California Energy Commission

Table 6: Selected Policies, Proceedings, Codes, Standards, or Protocols Advanced by Project Results

CEC EPIC Project	Building Component/ Market Sector	Annual Energy Cost Saving If Adopted Into Standards
Building Envelope/New Residential Construction	Building Envelope/ New Residential Construction	$29 million
Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	HVAC/ New Residential Construction	$7.4 million
Reinventing Residential Demand Response: Breaking Through the Barriers with Gamification and Devices	Residential Demand Response	$3.5 million
Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls	HVAC/ New Commercial Buildings	<$1 million
Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings	Lighting/ New Commercial Buildings	$700 million

Source: California Energy Commission

CHAPTER 2:
Electric Program Investment Charge Budget

This chapter summarizes the CPUC authorized budget for the CEC EPIC, as well as funding commitments and encumbrances, dollars spent on program administration, and other budget-related topics.

Authorized Budget

In 2018, the CPUC approved an EPIC budget for the third triennial investment cycle (2018–2020) in Decisions 18-01-008 and 18-10-052. Table 7 through Table 9 show the CEC funding for investment plans 2012–2014, 2015–2017, and 2018–2020, as approved by the CPUC.

Table 7: 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 8: 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 9: 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 EPIC, 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."[13]

Table 10 summarizes the committed project funds and encumbered project funds for each three-year EPIC investment plan. The data in this table are current as of December 31, 2020.

Table 10: Committed and Encumbered Project Funding by Electric Program Investment Charge Investment Plan (as of December 31, 2020)

Investment Plan	Approved Plan Project Funds	Committed Project Funds	Encumbered Project Funds
2012-2014	$331,800,000	$331,800,000	$328,246,114
2015-2017	$365,004,500	$365,004,500	$352,857,997
2018-2020	$397,380,000	$397,380,000	$164,520,306

Source: California Energy Commission

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

Approved Awards in 2020

In 2020, the CEC approved 54 new projects totaling nearly $132 million (Table 11).

Table 11: CEC Approved Electric Program Investment Charge Awards in 2020 by Solicitation

Solicitation Number and Title	Number of Awards	Award Amount for Solicitation
GFO-15-312. The EPIC Challenge: Accelerating the Deployment of Advanced Energy Communities	2	$14,092,388
GFO-15-325. Development, Demonstration and Deployment of Environmentally and Economically Sustainable Biomass-to-Energy Systems for the Forest and Food Waste Sectors	1	$4,999,830
GFO-18-305. Developing Lessons Learned, Best Practices, Training Materials and Guidebooks for Customer Side of the Meter Energy Storage	1	$1,000,000
GFO-18-902. Cost Share for Federal Funding Opportunities for Energy Research, Development, and Demonstration	1	$3,000,000
GFO-19-301. Advancing Next-Generation Heating, Cooling and Water Heating Systems	7	$15,752,343
GFO-19-302. Advance to Next-Generation Wind Energy Technology (Next Wind)	5	$7,999,979
GFO-19-303. Geothermal Energy Overcoming Technology Hurdles and Enabling Recovery of the MinerAl Lithium (Geothermal)	5	$14,000,000
GFO-19-304. Advanced Refrigeration and Heat Pumps for the Industrial Sector	5	$7,974,146
GFO-19-305. Developing non-Lithium Ion Energy Storage Technologies to Support California's Clean Energy Goals	7	$10,886,350
GFO-19-306. Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies	10	$30,500,971
GFO-19-307. Advancing Envelope Technologies for Single Family Residential Buildings, Low-rise Multifamily Buildings, and Mobile Homes	4	$7,767,949
GFO-19-308. Assessing Long-duration Energy Storage Deployment Scenarios to Meet California's Energy Goals	2	$2,754,955
GFO-19-310. Validating Capability of Second-life Batteries to Cost-Effectively Integrate Solar Power for Small-Medium Commercial Building Applications	4	$10,844,233
Grand Total	**54**	**$131,573,144**

Source: California Energy Commission

Dollars Spent on Program Administration

The CPUC EPIC budget requirements cap administrative costs at 10 percent. Expenditures for CEC administrative costs totaled about $14.7 million in Calendar Year 2020.

The CEC EPIC administrative costs for Calendar Years 2012 through 2020 were $102 million out of the $122.083 million from CPUC approved program administration budgets for the three EPIC investment plans. Therefore, the CEC's administrative costs are within the approved budgeted amount.

AB 523 requires the CEC to provide a brief description of the "impact on program administration from the allocations required to be made" by AB 523. The required allocations are 25 percent of EPIC funds for technology demonstration and deployment at sites in and benefiting disadvantaged communities and an additional 10 percent of EPIC funds for technology demonstration and deployment at sites in and benefitting low-income communities.

In 2020, the CEC allocated about 2 person-years to implement AB 523. These staff resources help coordinate effort among agreement managers to ensure diversity and equity are included across EPIC funding opportunities. EPIC program administration activities related to AB 523 include the following:

- CEC staff participated in public workshops and outreach to disadvantaged and low-income communities.
- Applicable EPIC solicitations set aside funding for projects in and benefitting disadvantaged and low-income communities.
- CEC staff expanded use of scoring criteria for projects that benefit disadvantaged and low-income communities. Competitive solicitations began using the new scoring criteria in 2019. CEC staff developed a scoring team to evaluate project proposals based on these scoring criteria.
- CEC staff conducted outreach to recruit organizations representing low-income and disadvantaged communities to Empower Innovation.
- CEC staff developed Empower Innovation events to support networking and gather stakeholder input from local governments and community based organizations.
- ERDD created the role of DACAG liaison to facilitate coordination with the DACAG and provided weekly input to the DACAG newsletter.

For further information on implementation of AB 523, please see "Energy and Equity: Assembly Bill 523 Implementation" in Chapter 1.

Funding Shifts

EPIC administrators must obtain CPUC approval to shift more than 5 percent of budgeted funds for each funding category or program area or to new categories of funding within an

approved EPIC triennial investment plan.[14] In 2020, the CEC did not shift or apply to shift funds between or to new funding categories or program areas.

Uncommitted and Unencumbered Funds and Interest Accrual

Uncommitted funds are those not committed during the planning of a solicitation. Unencumbered funds meet one of the following conditions:

- The funds are committed but have not been encumbered.
- After funds were encumbered, the funds were disencumbered from projects where the encumbrance period had expired, such as projects that were canceled or terminated with no CEC EPIC funds spent, and projects that were amended to reduce the original budget.

As of December 31, 2020:

- There are no uncommitted funds from the first, second, or third EPIC investment plans.
- Unencumbered funds from the *2012–2014 EPIC Investment Plan* were $3.6 million.
- Unencumbered funds from the *2015–2017 EPIC Investment Plan* were $12.1 million.
- All funds are committed from *2018–2020 EPIC Investment Plan.* The CEC plans to encumber the balance of funds from this plan by June 30, 2022.

In Calendar Year 2020, the CEC accumulated about $3.97 million in interest from all funds in the EPIC account. Due to administrative limitations, instead of returning accumulated interest, the CEC takes accumulated interest into account when submitting invoices to the IOUs. After the accumulated interest is determined for the prior year, the CEC subtracts the amount of accrued interest from invoices it submits to the IOUs.[15]

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

15 See CPUC Decision 13-11-025, page 105.

CHAPTER 3:
Electric Program Investment Charge Projects

Through EPIC, the CEC funds innovation to advance safety, reliability, and affordability in California's electricity system. The CEC awards EPIC funds through a competitive process to projects that will accelerate achievement of California's transformative clean energy policies to reduce greenhouse gas emissions and adapt to climate change.

CEC staff applies dedicated expertise to fund a strategic portfolio of EPIC research projects in the public interest. This portfolio of projects will make California's transition to 100 percent clean energy faster, lower cost, and more inclusive by supporting entrepreneurship, funding advanced energy communities, and providing public access to data and lessons learned.

EPIC advances innovations for resilience and safety, energy equity, and decarbonization of California's building, industry, agriculture, water treatment, electricity, and transportation sectors. Since the beginning of EPIC, the CEC has funded 385 project awards, encumbering about $846 million.

Summary of Project Awards

Table 12, Table 13, and Table 14 list the number of projects and total funding awarded since 2012 under each strategic objective of the *2012–2014 EPIC Investment Plan*, the *2015–2017 EPIC Investment Plan*, and the *2018–2020 EPIC Investment Plan*, respectively. These tables also indicate the investment area of each strategic objective: applied research and development (ARD), technology demonstration and deployment (TDD), and market facilitation (MF). The data in these tables are current as of December 31, 2020. There are a few instances where a single cross-cutting project is funded from two strategic objectives. As noted in the following tables, this occurs for one strategic objective in the *2015–2017 EPIC Investment Plan* and two strategic objectives in the *2018–2020 EPIC Investment Plan*. In each instance, the project is counted only once.

Table 12: Summary of Projects Awarded Under the CEC 2012-2014 EPIC Investment Plan by Strategic Objective

Area	Strategic Objective	Number of Projects	Total Funding
AR&D	S1: Develop Next-Generation End-Use Energy Efficiency Technologies and Strategies for the Building Sector	21	$38,815,729
AR&D	S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-Side-of-the-Meter Energy Choices	10	$30,144,179
AR&D	S3: Develop Innovative Technologies, Tools, and Strategies to Make Distributed Generation More Affordable	12	$18,408,700

Area	Strategic Objective	Number of Projects	Total Funding
AR&D	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
AR&D	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
AR&D	S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020	5	$5,401,868
AR&D	S7: Develop Operational Tools, Models, and Simulations to Improve Grid Resource Planning	2	$1,690,055
AR&D	S8: Integrate Grid Level Energy Storage Technologies and Determine Best Applications That Provide Locational Benefits	5	$8,673,198
AR&D	S9: Advance Technologies and Strategies That Optimize the Benefits of Plug-in Electric Vehicles to the Electricity System	5	$6,681,669
AR&D	S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies	6**	$19,435,655
TD&D	S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies	20	$52,189,861
TD&D	S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies	13**	$37,983,642
TD&D	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

Area	Strategic Objective	Number of Projects	Total Funding
MF	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
MF	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
MF	S18: Guide EPIC Investments Through Effective Market Assessment, Program Evaluation, and Stakeholder Outreach	7**	$16,954,539
All	**2012-2014 EPIC Plan Subtotal**	**172**	**$328,246,114**

*** Seven 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.**

This table does not include five projects from the 2012–2014 EPIC Plan that were approved at a CEC business meeting and later canceled or terminated by the recipient. No work was done on these projects, and no EPIC funds were spent.

The amounts in the "Total Funding" column represent the project funding that was approved at a CEC business meeting and any adjustments made thereafter—adjustments made thereafter are also included in Appendix C EPIC Project Status Report of this report.

Source California Energy Commission

Table 13: Summary of Projects Awarded Under California Energy Commission 2015-2017 Electric Program Investment Charge Investment Plan by Strategic Objective

Area	Strategic Objective	Number of Projects	Total Funding
AR&D	S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.	34	$65,427,940
AR&D	S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.	19	$26,398,707

Area	Strategic Objective	Number of Projects	Total Funding
AR&D	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
AR&D	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
AR&D	S6: Advance the Use of Smart Inverters as a Tool to Manage Areas With High Penetrations of PV.	1	$2,935,822
AR&D	S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.	6***	$14,189,656
AR&D	S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.	4	$5,326,250
AR&D	S10: Advance the Early Development of Breakthrough Energy Concepts.	Project counted in S10 2012-2014 Investment Plan	$20,211,957
AR&D	S11: Provide Federal Cost Share for Applied Research Awards.	7	$4,950,000
TD&D	S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions Through Demonstrations in New and Existing Buildings.	16** / ***	$56,433,389
TD&D	S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.	5	$19,739,817
TD&D	S14: Take Microgrids to the Next Level: Maximize the Value to Customers.	9	$44,978,120
TD&D	S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market, and Improve Grid Reliability.	4***	$7,087,640
TD&D	S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.	4	$10,616,252

Area	Strategic Objective	Number of Projects	Total Funding
TD&D	S17: Provide Federal Cost Share for Technology Demonstration and Deployment Awards.	2	$2,999,822
MF	S18: Foster the Development of the Most Promising Energy Technologies Into Successful Businesses.	5***	$31,110,790
MF	S19: Facilitate Inclusion of Emerging Clean Energy Technologies Into Large-Scale Procurement Processes.	4	$16,983,471
MF	S20: Accelerate the Deployment of Energy Technologies in IOU Territories Through Innovative Local Planning and Permitting Approaches.	2	$2,487,609
MF	S21: Inform Investments and Decision-Making Through Market and Technical Analysis.	4	$4,984,530
All	**2015-2017 EPIC Plan Subtotal**	**146**	**$352,857,997**

**** Three projects used funds from *2015–2017 EPIC Investment Plan* but addressed more than one strategic objective within the plan. These projects are indicated under one 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.**

***** Five projects used funds from both the *2015–2017 and 2018–2020 EPIC Investment Plans*. These projects are indicated under the second plan (2015–2017) 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.**

This table does not include two projects from the 2015–2017 EPIC Plan that were approved at a CEC business meeting and later terminated by the recipient. No work was done on these projects, and no EPIC funds were spent.

The amounts in the "Total Funding" column represent the project funding that was approved at a CEC business meeting and any adjustments made thereafter; adjustments made thereafter are also included in Appendix C EPIC Project Status Report of this report.

Source: California Energy Commission

Table 14: Summary of Projects Awarded Under the California Energy Commission 2018-2020 Electric Program Investment Charge Investment Plan by Strategic Objective

Area	Strategic Objective	Number of Projects	Total Funding
AR&D	1.2 Showcase Benefits of Advanced Window and Building Envelope Systems	3	$5,917,949
AR&D	1.3 Meeting the Demand for Efficient and Environmentally Friendly Heating, Ventilation, and Air-Conditioning and Refrigeration Systems	4	$7,414,714
AR&D	1.7 Enable Cost-Effective Decarbonization of California's Industrial Sector	5	$7,974,146
AR&D	2.3 Define and Improve the Customer's Business Proposition of Integrated Distributed Storage	11	$21,730,583
AR&D	3.1 Accelerate Broad Adoption of Automated Demand Response Capabilities That Provide the Grid-Flexible Response Services	2	$5,537,436
AR&D	3.4 Define and Demonstrating the Locational Benefit and Best Configuration of Grid-Level Energy Storage as the California Grid Transitions to More Distributed Energy Resources	2	$2,754,955
AR&D	4.1 Advance Emerging Thin-Film PV Technologies for High-Value Applications	3	$2,593,260
AR&D	4.2 Develop Technologies That Enable Increased Wind Capacity in California	3	$6,999,979
AR&D	4.3 Increase the Strategic Value of Flexible CSP and Geothermal to the Electricity System	4	$8,000,000
AR&D	6.1 Reduce the Energy Intensity Required to Supply and Treat Water	1	$3,000,000
AR&D	7.2 Increase the Resiliency of the Electricity System to Climate Change and Extreme Weather Events	Project counted under S7, 2015-2017 Investment Plan	$978,584

Area	Strategic Objective	Number of Projects	Total Funding
AR&D	7.3 Evaluate Strategies to Mitigate the Impacts of the Electricity System on the Environment and Public Health and Safety	2	$1,000,000
TD&D	1.2 Showcase Benefits of Advanced Window and Building Envelope Systems	1	$1,850,000
TD&D	1.3 Meeting the Demand for Efficient and Environmentally Friendly Heating, Ventilation, and Air-Conditioning and Refrigeration Systems	1	$2,800,193
TD&D	2.3 Define and Improve the Customer's Business Proposition of Integrated Distributed Storage	12	$39,194,960
TD&D	2.4 Incentivize DER Adoption Through Innovative Strategies at the Local Level	2	$16,612,967
TD&D	4.4 Improve the Value Proposition of Bioenergy	2	$10,999,830
MF	2.3 Define and Improve the Customer's Business Proposition of Integrated Distributed Storage	1	$1,000,000
MF	5.2 Accelerate the Most Promising Energy Technologies From Prototype to Market Entry	8	$18,160,750
All	**2018-2020 EPIC Plan Subtotal**	**67**	**$164,520,306**

This table does not include one project from the 2018–2020 EPIC Plan that was approved at a CEC business meeting and later terminated by the recipient. No work was done on these projects, and no EPIC funds were spent.

The amounts in the "Total Funding" column represent the project funding that was approved at a CEC business meeting and any adjustments made thereafter; adjustments made thereafter are also included in Appendix C EPIC Project Status Report of this report.

Source: California Energy Commission

Electric Program Investment Charge 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 for each project is:

- Investment program period.

- Program administrator.
- Project name.
- Project type.
- Brief description of project.
- Date of award.
- Whether project was 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, the number of bidders passing the initial pass/fail screening for project.
- If competitively selected, the name of selected bidder.
- If competitively selected, the rank of the selected bidder in the selection process.
- If competitively selected, an explanation of why the bidder was not the highest scoring bidder and why a lower scoring bidder was selected.
- If interagency or sole source agreement, date the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization.
- Whether the recipient for the award identifies 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.

Completed Projects

In 2020, awardees completed 47 EPIC projects. (See Appendix B for more information.) Final project reports by awardee (available upon request) have been or will be submitted to the CEC.

CEC staff continues to ensure EPIC final reports meet the formatting requirements specified in California Government Code Sections 7405 and 11135 and the Web Content Accessibility Guidelines. Once approved, finalized, and formatted to be digitally accessible, each final project report is posted on the CEC website and available at the Research and Development Reports and Publications page at https://www.energy.ca.gov/energy-rd-reports-n-publications. Table 15 provides information on the final project reports currently available online.

Table 15: Published Final Reports for CEC EPIC-Funded Projects Completed in 2020

Agree-ment #	Company	Project Name	Invest-ment Program Period	Total EPIC Funds	Final Report Link
300-17-003	Guidehouse, Inc.	Distributed Energy Resources (DER) Roadmap	2015-2017 EPIC Investment Plan	$499,065	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2021-010
300-17-005	Energetics Incorporated	Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation	2015-2017 EPIC Investment Plan	$338,059	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-062
EPC-15-004	Electric Power Research Institute, Inc.	Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand	2012-2014 EPIC Investment Plan	$2,834,721	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2021-028
EPC-15-019	Regents of University of California, Davis Campus	Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	2012-2014 EPIC Investment Plan	$1,212,186	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2021-009
EPC-15-037	Lawrence Berkeley National Laboratory	Smart Ventilation for Advanced California Homes	2012-2014 EPIC Investment Plan	$1,500,000	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-050

Agree-ment #	Company	Project Name	Invest-ment Program Period	Total EPIC Funds	Final Report Link
EPC-15-039	The Regents of the University of California, Berkeley Campus	Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle	2012-2014 EPIC Investment Plan	$499,181	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-075
EPC-15-048	Alternative Energy Systems Consulting, Inc.	Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources	2012-2014 EPIC Investment Plan	$3,996,560	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-057
EPC-15-092	Tomorrow Water dba BKT United	Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal	2012-2014 EPIC Investment Plan	$1,722,072	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-079
EPC-16-021	Lawrence Berkeley National Laboratory	High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network	2015-2017 EPIC Investment Plan	$1,672,639	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2021-004
EPC-16-056	Lawrence Berkeley National Laboratory	Performance Evolution, Specification and Verification of Building Control Sequences	2015-2017 EPIC Investment Plan	$1,000,000	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2021-012

Agree-ment #	Company	Project Name	Invest-ment Program Period	Total EPIC Funds	Final Report Link
EPC-16-065	Zero Net Energy (ZNE) Alliance	California E-Bus to Grid Integration Project	2015-2017 EPIC Investment Plan	$3,327,953	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2021-014
EPC-16-079	Electric Power Research Institute, Inc.	Impact Assessment and Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration	2015-2017 EPIC Investment Plan	$2,935,822	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2021-013
EPC-17-003	Clean Power Research, L.L.C.	Developing a Comprehensive, System-wide Forecasting to Support High-Penetration Solar	2015-2017 EPIC Investment Plan	$750,000	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-060
EPC-17-004	Energy and Environ-mental Economics, Inc. (E3)	Enhanced Modeling Tools to Maximize Solar + Storage Benefits	2015-2017 EPIC Investment Plan	$987,379	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-058
EPC-17-029	Cal Poly Corporation	Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy	2015-2017 EPIC Investment Plan	$199,978	https://www.energy.ca.gov/publications/displayOneReport_cms.php?pubNum=CEC-500-2020-064

Source: California Energy Commission

Description of Projects

Appendix B provides project write-ups for all active, approved, completed, and terminated (if EPIC funds were spent) projects in 2020, following the EPIC annual report outline from CPUC Decision 13-11-025, Attachment 5 (Item 4c of the outline).

CHAPTER 4: Conclusions

Key Results for 2020 for the California Energy Commission Electric Program Investment Charge

Examples of the accomplishments EPIC research has achieved through 2020 are provided in the Executive Summary and Table 2: Quantifiable Benefits of California Energy Commission Electric Program Investment Charge Investments by Impact Category in Chapter 1.

Next Steps for the Electric Program Investment Charge Investment Plan

This section lists next steps scheduled for 2021 organized by investment topic. In addition to the topics listed below, the CEC has scheduled the following cross-cutting public forums:

- On January 6, 2021, CEC staff held a workshop to discuss preliminary research themes and initiatives for the EPIC Interim Investment Plan for 2021 to 2022. Written comments were due January 19, 2021.
- On February 16, 2021, CEC staff submitted a motion for approval of the EPIC Interim Investment Plan in Phase 2 of Rulemaking 19-10-005.
- CEC staff anticipates a CPUC public comment period followed by a proposed decision for consideration at a CPUC business meeting in spring 2021.
- CEC staff plans to hold one or more public scoping workshops in spring 2021 on the EPIC Investment Plan for the 2022-2025 funding collection period.
- CEC staff plans to submit an application to the CPUC for the 2022-2025 EPIC investment plan on October 1, 2021.

Entrepreneurial Ecosystem

- There are two upcoming opportunities to submit applications for the 2020 BRIDGE solicitation (GFO-20-301). This solicitation would help clean energy start-up companies bridge the gap from their previous public funding awards to private investment.
    - June 11, 2021 is the deadline to submit applications for the third round.
    - October 8, 2021 is the deadline to submit applications for the fourth round.

Resilience and Safety

- CEC staff anticipates releasing an EPIC solicitation for research to support a climate resilient transition to a clean electricity system in fall of 2021.
- CEC staff plans to release a competitive solicitation to support improved understanding of health and equity issues related to electrification.
- CEC staff plans to release a competitive solicitation to provide increased resiliency during grid outages through the development and demonstration of clean energy alternatives to mobile fossil fuel backup generators. The systems can use any type of renewable generation combined with energy storage and must be mobile for deployment to support communities during grid outages, including public safety power

shutoffs. The awarded projects will be in three groups: two in technology demonstration and deployment for systems that can support small or large loads, and one in applied research and development to develop systems that can fully replace mobile fossil fuel systems supporting larger loads.

Building Decarbonization

- CEC staff plans to hold a workshop to support large commercial building decarbonization efforts. Discussion topics may include but are not limited to potential strategies and advanced technologies for decarbonization while minimizing economic impact on building owners and tenants.
- CEC staff plans to release a competitive solicitation to support advanced prefabricated zero-carbon homes. This effort aims to develop zero- or near-zero carbon, cost-effective, prefabricated homes that can be readily deployable in low-income or disadvantaged communities.

Grid Decarbonization and Decentralization

- CEC staff will award funding in GFO-20-304, Evaluating Bidirectional Energy Transfers and Distributed Energy Resource Integration for Medium- and Heavy-Duty Fleet Electrification, which will enable grid-friendly vehicle electrification. The solicitation seeks to fund:
    - Projects to develop and demonstrate a distributed energy resource package, including distributed generation and storage, to serve the duty cycles and charging infrastructure requirements of a fleet of medium-duty and heavy-duty battery electric vehicles while reducing stress on the electric grid.
    - Projects to demonstrate and evaluate cost management, resilience, and renewable integration use cases for: bidirectional energy transfers from electric school buses; or integrated distributed energy resource packages tailored for medium- and heavy-duty fleet electrification. The goal of these demonstrations is to provide cost and performance data that can inform other medium- and heavy-duty battery electric vehicle deployments, and to advance commercial offerings that accelerate medium- and heavy-duty fleet electrification.
- CEC staff plans to release a competitive grant solicitation supporting the development of floating offshore wind in California. Anticipated scope will include manufacturing, testing, validation, inspection and monitoring of floating offshore wind components as well as study on impacts on marine biodiversity and habitats, currents, and upwelling.

Industrial, Agricultural, and Water Innovation

- CEC staff plans to hold a workshop focusing on carbon capture and use for the industrial, agricultural and water sectors. Discussion topics may include target markets, technology status, evaluation of cost-effective approaches, and research needs.
- CEC staff plans to hold a workshop focusing on applications for green hydrogen in the industrial sector. Discussion topics may include potential uses and estimates of the quantitative potential for green hydrogen, feasibility of supplying green hydrogen to industrial facilities, hydrogen combustion applications, evaluation of cost-effective approaches, and research needs.

- CEC staff plans to release a competitive solicitation focused on research opportunities to decarbonize commercial and industrial cold storage facilities that can include implementation of advanced energy efficiency, use of low global warming refrigerants, and controls to maximize grid flexibility.
- CEC staff plans to release a competitive solicitation focused on improving the energy efficiency and load flexibility of indoor farms developed in urban areas. This effort aims to reduce the carbon footprint of these operations and to provide opportunities in low income or disadvantaged communities.

Transportation

- CEC staff will release a competitive solicitation titled "Research Hub for Electric Technologies in Truck Applications" that will accelerate heavy-duty truck electrification of a highly trafficked freight corridor.
- CEC staff will release a competitive solicitation titled "Research and Development of High-Value Recycling Pathways for Lithium-ion Batteries Solicitation" that will develop technologies and capacity in California to recover valuable materials from growing lithium-ion battery waste streams.
- CEC staff will develop and host a workshop on bidirectional plug-in electric vehicles and chargers that can power building and home loads during grid outages.

Issues

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

Timing of Approval of Investment Plans

In Decision 20-08-042 in Phase 1 of Rulemaking 19-10-005, the CPUC renewed the EPIC for ten years, January 1, 2021 through December 31, 2030, and authorized two five-year investment plans EPIC 4 (2021-2025) and EPIC 5 (2026-2030). The CPUC directed the CEC to file an investment plan to the CPUC by October 1, 2021 to cover the five-year period of EPIC 4.[16]

Decision 20-08-042 also stated that the CEC may file an interim investment plan as part of a motion in Phase 2 of Rulemaking 19-10-005. The CPUC recognized that to maintain continuity of the EPIC, the CEC may need funding to begin work on new EPIC projects before a full EPIC 4 Investment Plan is developed with public and stakeholder input and approved by the CPUC. Because the EPIC 4 Investment Plan is due in October 2021, and the CPUC will need time to consider the plan, approval is not expected until early 2022.

To maintain continuity in EPIC funding opportunities and help stimulate economic growth as California's economy recovers from the COVID-19 pandemic, the CEC filed a motion in Phase 2 of Rulemaking 19-10-005 seeking CPUC approval for an EPIC Interim Investment Plan for 2021, the first year of EPIC 4, by no later than April 15, 2021.

16 CPUC D.20-08-042, ordering paragraphs 1-3, 7.

The CEC developed the Interim Investment Plan to serve as a bridge between the CEC's third triennial investment plan ("EPIC 3") (funding collection period 2018-2020) and a full five-year EPIC 4 Investment Plan (2021-2025). The Interim Investment Plan focuses on reliability, resilience, and initiatives to scale-up deployment of energy storage, demand response, and clean energy generation technologies. This plan will enable the CEC to continue to fund projects critical to maintaining research momentum needed to achieve the state's clean energy goals faster, benefit ratepayers, and support economic recovery.

Looking forward, the CEC plans to hold scoping workshops in 2021 to inform development of the CEC's EPIC 4 Investment Plan for 2022-2025. The CEC will file the proposed plan with the CPUC by October 1, 2021.

Senate Bill 115 Authorizes Follow-on Funding Process for Fiscal Year 2020-2021

The Budget Act of 2020 (Senate Bill 115, Committee on Budget and Fiscal Review, Chapter 40, Statutes of 2020) allows the CEC to provide follow-on funding during fiscal year 2020–2021 to a limited number of EPIC agreements that meet the criteria identified in the legislation.[17] SB 115 directs the CEC to identify in the EPIC annual reports for 2020 and 2021, the projects that received this follow-on funding, the amount of follow-on funding each project received, and the method and criteria that was used for their selection.

In 2020, there were no projects that received this follow-on funding; however, the CEC developed the method and criteria and began the process for selecting awards for SB 115 follow-on funding. The first proposed awards are expected to be considered at a CEC Business Meeting in spring 2021.

Consistent with SB 115, the CEC developed two sets of criteria to invite and select proposed projects: 1) administrative screening; and 2) assessment of commercialization potential and policy impact. The criteria are listed below:

Section I. Administrative Screening (Per SB 115, in addition to meeting all the existing requirements of EPIC, all of the following criteria must also be met for the proposed project):

- The project has a prime recipient that is located in California.
- The project will spend a minimum of 80 percent of its funding from the program in California.
- The project has received funding for the original project or technology through a competitive bid process from a state or federal agency.
- The project has demonstrated significant results under its previous award.
- The project has technology breakthrough potential that can enable the state to achieve its statutory energy policy goals ahead of schedule.

17 Item 3360-101-3211 of Section 2.00 of the Budget Act of 2020.

- The project can address near-term priorities impacting the electricity sector and its customers such as wildfires and associated power disruptions.
- Absent follow-on funding, the project would experience a gap in funding that would likely prevent the technology from achieving significant technological advancement, negatively impact the ability of the project to attract sufficient private investment, or prevent the project's commercialization and associated sales revenue.
- The project has not previously received follow-on funding through a non-competitive process.
- For Technology Demonstration and Deployment projects, the project has a minimum of 20 percent match share.[18]

Section II. Commercialization Potential and Policy Impact. A score of 80 or higher from each member of the evaluation committee is required for the project to be recommended for follow-on funding.[19]

- The recipient has identified a target market(s) for the proposed technology, the size of the market(s) in California, and the competitive advantages of their technology solution over current commercially available solutions in this market(s).
- The recipient has quantified the expected benefits to electric ratepayers based on a reasonable level of anticipated market uptake.
- The recipient has demonstrated estimated quantified monetary benefits to electric ratepayers that exceed the prior award amount by 10X in five years. For example, if the amount of the prior award is $4 million, the quantified monetary benefits to electric ratepayers must be greater than $40 million.
- The project can be operational in time to address near-term priorities impacting the electricity sector and its customers including the following:
    - Wildfires and PSPS-related outages
    - Grid and customer service reliability
- The recipient has demonstrated additional use cases that will provide critical new information for use in policy proceedings and decisions.

The CEC staff conducts a preliminary review of previously funded EPIC projects based on the administrative screening and commercialization potential and policy impact criteria listed above. Using results of this preliminary review, CEC staff notifies past recipients of the

18 The CEC requires match funding for demonstration projects, but the amount required may vary depending on the goals of each competitive solicitation. For example, GFO-19-306 Demonstrating Long Duration and Title 24-Compatible Energy Storage Technologies, required 50 percent match funding for one group and 20 percent match funding for the other groups specified in the solicitation. For SB 115 follow-on funding, the CEC personnel created this 20 percent match requirement. This may change as CEC personnel continue to move forward and gain more experience with this new process.

19 The criteria in this section are not from SB 115 and have been created by CEC personnel. Accordingly, they may change as CEC personnel continue to move forward and gain more experience with this new process.

invitation to apply for SB 115 follow-on funding and provides application forms and materials outlining the process.

Following CEC receipt of an invited application for SB 115 follow-on funding, the ERDD Deputy Director, or designee, identifies an evaluation committee composed of a minimum of three internal subject matter experts. The CEC evaluation committee schedules a one-hour project evaluation meeting with the applicant and the evaluation committee. At this meeting, the applicant provides a presentation on the proposed project for follow-on funding and addresses questions from the evaluation committee. The presentation should include a discussion of:

- Performance metrics and technical milestones that were achieved under the prior project.
- Performance metrics and technical milestones being proposed for the follow-on project.
- The technology's competitive advantages over existing commercial offerings, if applicable.
- Market adoption potential in California, if applicable.
- Quantified and qualitative benefits to electric ratepayers based on a reasonable estimate of market adoption, if applicable.

Following the evaluation interview, the evaluation committee scores the proposal for the follow-on project based on the application package and information from the evaluation interview. Each committee member scores the proposed project individually. Subsequently, the evaluation committee members discuss their scores at a scoring meeting. A score of 80 or higher from each member of the evaluation committee is required for the project to be recommended for follow-on funding.

After scoring, the evaluation committee meets with the ERDD Deputy Director or designee to discuss the follow-on proposal, the proposal strengths and weaknesses, the committee's recommendation whether to award follow-on funding, and recommended revisions, if any, to the proposed follow-on project to strengthen its value and benefits.

Following this meeting, the ERDD Deputy Director or designee notifies the applicant whether the proposed project has been recommended for SB 115 follow-on funding and CEC staff begins working with the recipient to develop the agreement package, including the statement of work and budget. If after 10 days, the CEC staff and recipient have not reached an agreement, the CEC staff has the option to continue negotiations or to end negotiations and move on from the proposed follow-on project. Once the CEC staff and recipient have completed agreement development, the proposed follow-on agreement will be considered for approval at a CEC Business Meeting.

Other Issues

Three projects were terminated in 2020. These projects began research but were unable to finish successfully.

In 2020, due to COVID-19 and shelter in place orders, the CEC extended the project term for 90 EPIC agreements, increasing time to complete projects.

LIST OF ACRONYMS

Term	Definition
AB	Assembly Bill
ARD	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
CARB	California Air Resources Board
CEC	California Energy Commission
CO_2	Carbon dioxide
CPUC	California Public Utilities Commission
Disadvantaged community	A community that scores at or above 75 percent in the version of CalEnviroScreen that was available at the time of project application.
DC	Direct current
DACAG	Disadvantaged Community Advisory Group
EASE	Electric Access System Enhancement
EPIC	Electric Program Investment Charge
EPRI	Electric Power Research Institute
ERDD	Energy Research and Development Division
ETCC	Emerging Technologies Coordinating Council
GW	gigawatts
IoT	Internet of Things
IOU	Investor-owned utility
JLBC	Joint Legislative Budget Committee
LGBTQ	Lesbian, gay, bisexual, transgender, and queer
MF	Market facilitation
NOPA	Notice of proposed awards
PG&E	Pacific Gas and Electric Company
PICG	Policy + Innovation Coordination Group
PV	Photovoltaic
SB	Senate Bill

Term	Definition
SCE	Southern California Edison Company
SDG&E	San Diego Gas & Electric Company
Title 24 Energy Code	California Code of Regulations, Title 24, Parts 6 and 11
TDD	Technology deployment and demonstration
USDOE	United States Department of Energy

APPENDICES

The following appendices are available as a separate volume (Publication Number CEC-500-2021-029-AP-CMF):

- Appendix A: CEC EPIC Reporting Requirements for 2020
- Appendix B: CEC EPIC Project Write-Ups for 2020 Active, Completed, or Terminated Projects
- Appendix C: CEC EPIC Project Status Report