CALIFORNIA ENERGY COMMISSION

California Energy Commission

STAFF REPORT

Electric Program Investment Charge 2019 Annual Report

Appendices A-C

Gavin Newsom, Governor

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APPENDIX A:
CEC EPIC Reporting Requirements for 2019

The California Energy Commission (CEC) is committed to full compliance with all EPIC reporting and informational requirements. The following table (A-1) lists all CEC EPIC reporting and informational requirements for Calendar Year 2019. These requirements include those specified in the Public Resources Code and pursuant to California Public Utilities Commission rulemakings and decisions.

Table A-1: Energy Commission EPIC Reporting and Informational Requirements for Calendar Year 2019

Energy Commission Requirement	Status	Anticipated Completion Date
A. Annual Report: CPUC D.12-05-037, Ordering Paragraph (OP) 16 requires EPIC administrators to file an annual report each year on February 28, 2013 – February 28, 2020 with the Director of the Commission's Energy Division.	This annual report has been prepared in accordance with applicable CPUC reporting requirements and will be filed with the CPUC.	2/28/2020
B. Service: CPUC D. 12-05-037, OP 16 requires service of the annual report on all parties in the most recent EPIC proceeding; all parties to the most recent general rate case of each IOU; and each successful and unsuccessful applicant for an EPIC funding award during the previous calendar year.	This annual report will be served on all parties in the most recent EPIC proceeding; all parties to the most recent general rate case of each IOU; and each successful and unsuccessful applicant for an CEC EPIC funding award during the previous calendar year.	2/28/2020

Energy Commission Requirement	Status	Anticipated Completion Date
C. Information Availability: CPUC D.13-11-025, OP 13 requires EPIC administrators, except when valid reasons exist for confidentiality, to make all data, findings, results, computer models and other products developed through EPIC available upon request consistent with the treatment of intellectual property requirements.	The CEC has and will continue to respond to all requests for information in accordance with any confidentiality requirements and consistent with the treatment of intellectual property requirements. Requests can be sent to erdd@energy.ca.gov.	As requested
D. Project Reporting: CPUC D.13-11-025, OP 14 requires annual reports to include a final report for every project completed during the previous year, including a comprehensive description of the project, detailed findings and results, a summary of all data collected, and how the data may be accessed.	Table 12 in Chapter 3 of this annual report entitled Completed Electric Program Investment Plan Funded Projects in 2019, contains information regarding projects completed in 2019.	2/28/2020

Energy Commission Requirement	Status	Anticipated Completion Date
E. Awards: CPUC D. 13-11-025, OP 15 requires annual reports to identify the use of noncompetitive awards.	Appendices B and C to this report identify the use of any non-competitive awards.	2/28/2020
F. Project Reporting: CPUC D.13-11-025, OP 17 requires annual reports to include project-level information on the number of bidders passing the initial pass/fail screening; the rank of the selected bidder; and if the selected bidder was not the highest scoring bidder, the project status report must also explain why a lower scoring bidder was selected.	Appendices B and C to this annual report contain project-level information on passing/failed bidders, rank of selected bidder, and an explanation if selected bidder was not highest scoring bidder.	2/28/2020
G. Project Reporting: CPUC D.13-11-025, OP 18 requires a justification for contracts or grants exempted from competitive bidding. Additionally, CPUC D. 18-10-052, pages 22-23 states that administrators should include a detailed explanation for the use of non-competitive processes.	Appendix B to this annual report includes a justification for any non-competitive awards for active or approved projects in 2018.	2/28/2020

Energy Commission Requirement	Status	Anticipated Completion Date
H. Annual Report: CPUC D. 13-11-025 OP 22 requires that the annual report follow the outline specified in Attachment 5 thereto.	This annual report follows the outline as specified in D.13-11-025 Attachment 5.	2/28/2020
I. Annual Report: CPUC D. 13-11-025 OP 23 requires the information in Attachment 6 thereto to be included as an electronic spreadsheet to report on projects described in section 4.b. of the annual report outline from CPUC D. 13-11-025, Attachment 5.	A project status report electronic spreadsheet detailing the information required under CPUC D. 13-11-025 Attachment 6 is included as Appendix C to this annual report and will be filed and served in electronic spreadsheet format as well.	2/28/2020
J. Annual Report: CPUC D. 13-11-025 OP 27 requires the annual report to identify the metrics used for each project, either from CPUC D. 13-11-025 Attachment 4 or additional metrics where appropriate.	Appendices B and C to this annual report identify the applicable metrics used for each project.	2/28/2020

Energy Commission Requirement	Status	Anticipated Completion Date
K. Information Availability: CPUC D. 13-11-025, OP 29(b) requires that, at the CPUC's request, the CEC give the CPUC full access rights to all EPIC research, development, and demonstration, reports, intellectual property (IP), and data to which the CEC has access, with appropriate protections for proprietary data and IP against public disclosure.	The CEC remains able and willing to comply with any CPUC requests pursuant to this requirement. Requests can be sent to ERDD@energy.ca.gov.	As requested.
L. Information Availability: CPUC D. 13-11-025, page 64 encourages the CEC to make its annual reports accessible to the public on its EPIC webpage and through its public advisor.	The CEC posts its EPIC annual reports on its EPIC webpage and makes its reports available through its public advisor's office.	2/28/2020
M. Project Reporting: CPUC D. 15-04-020, OP 6 requires the identification of any specific CPUC proceedings addressing issues related to each EPIC project.	Appendix B of this annual report identifies applicable CPUC proceedings for each project.	2/28/2020

Energy Commission Requirement	Status	Anticipated Completion Date
N. Joint Project Reporting: CPUC D. 15-04-020, OP 24 requires that if there are joint IOU and CEC projects, the IOU shall report the project title and amount of IOU funding used for the joint project(s) and the CEC shall be responsible for all other substantive reporting.	Appendix C provides all substantive reporting for CEC EPIC projects, including any joint IOU and CEC projects.	2/28/2020
O. Project Reporting: CPUC D. 15-04-020, page 53 requires that if an IOU administrator chooses to be a necessary partner on an CEC EPIC project, the IOU may use its EPIC funds for in-house costs and the IOU's reports shall identify the CEC project title and amount of IOU funding used, but the CEC shall be responsible for all other substantive reporting as with all its other projects.	Appendix C provides all substantive reporting for CEC EPIC projects, including any projects where an IOU is a necessary partner.	2/28/2020

Energy Commission Requirement	Status	Anticipated Completion Date
P. Annual Report to Legislature: Public Resources Code § 25711.5(f) requires an annual report to the Legislature. The annual report must contain all information as described in § 25711.5(f)(1)-(7) as follows: (1) A brief description of each project for which funding was awarded in the immediately prior calendar year, including name of the recipient, award amount, a description of how the project is thought to lead to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals, and a description of why the project was selected. (2) A brief description of each EPIC funded project that was completed in the immediately prior calendar year, including recipient name, award amount, and project outcomes. (3) A brief description of each funded project for which an award was made in the previous years but that is not completed, including recipient name, award amount, and a description of how the project will lead to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals. (4) Identification of award recipients that are California-based entities, small businesses, or businesses owned by women, minorities, or disabled veterans. (5) Identification of which awards were made through a competitive bid, interagency agreement, or sole source method, and any action of the Joint Legislative Budget Committee for each award made through an interagency agreement or sole source method. (6) Identification of the total amount of administrative and overhead costs incurred for each project. (7) A brief description of the impact on program administration from the low-income and disadvantaged community allocations required under Public Resources Code § 25711.6, including any information that would help the Legislature determine whether to reauthorize those allocations beyond June 30, 2023.	This annual report identifies the required information from Public Resources Code § 25711.5(f)(1)-(7) and will be provided to the Legislature after CEC adoption at a Business Meeting.	4/30/2020

Energy Commission Requirement	Status	Anticipated Completion Date
Q. Annual Report to Legislature: CPUC D.13-11-025, OP 29 requires that the annual report prepared and submitted to the Legislature pursuant to Public Resources Code § 25711.5, also be submitted to the CPUC.	The annual report prepared and submitted to the Legislature pursuant to Public Resources Code § 25711.5(f) will be submitted to the CPUC upon submittal to the Legislature.	4/30/20

Source: California Energy Commission

APPENDIX B:
CEC EPIC Project Write-Ups for 2019 Active, Completed, or Terminated Projects

Appendix B provides project write-ups for the projects that had the following status during 2019: active, completed, or terminated (with EPIC funds spent). Each project write-up includes and expands upon the following information required in Attachment 5 to CPUC Decision 13-11-025:

- Investment Plan Period (included in Investment Plan)
- Assignment to Value Chain
- Objective (included in Project Description)
- Scope (included in Project Description)
- Deliverables (included in Project Description)
- Metrics
- Schedule (included in Project Term)
- EPIC Funds Encumbered
- EPIC Funds Spent
- Partners (if applicable)
- Match Funding (if applicable)
- Match Funding Split (if applicable)
- Funding Mechanism (if applicable)
- Treatment of Intellectual Property (if applicable)
- Status Update

Additional items provided in each project write-up include:

- Program Area and Strategic Objective
- Issue
- How the Project Leads to Technological Advancement or Breakthroughs
- CPUC Proceedings Addressing Issues Related to this EPIC Project
- Total Budgeted Administrative and Overhead Costs
- Number of Initial Passing Applicants/Bidders
- Rank of Selected Applicant/Bidder
- Explanation of selection if not highest scoring applicant/bidder

Project Name: 300-15-004 - Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions

Recipient/Contractor: The Regents of the University of California on behalf of the Merced Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

California has traditionally depended heavily on hydropower as a flexible generation source. However, a warming climate will alter the magnitude and timing of precipitation and runoff, decreasing hydropower generation. Optimization models have been used as a tool to explore ways to maximize hydropower generation and revenue. However, these models do not address the realities of a warming climate and other generation constraints, such as required downstream water temperatures or flow levels. This project is developing an optimization model that addresses the economic and environmental constraints on hydropower generation, as well as the legal limitations on these operations.

Project Description:

This project is part of the U.S.-China Clean Energy Research Center for Water-Energy Technologies (CERC-WET), co-funded by the U.S. Department of Energy and the Government of China. This project is one of several EPIC-funded research endeavors addressing sustainable hydropower under a warming climate. The project develops an optimization model to ensure efficient hydropower operations, but this model will differ from existing models by taking into account different climate scenarios and regulatory constraints.

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

Prior studies of the trade-offs between electricity generation and environmental protection have been based on models that do not take real-world policy constraints such as legal and regulatory limitations into account. Additionally, this research will create models to optimize hydropower generation that account for changes in precipitation and runoff due to a warming climate while sustaining downstream environments. These tools will inform decision-making in the context of trade-offs of electricity generation and

environmental protection under both a changing climate and relevant legal and regulatory constraints.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: Hydropower generation in California represents a low cost source of clean energy and ancillary services. Reduced levels of hydropower generation forces investor owned utilities to rely on more expensive energy sources; these costs result in upward pressure on electricity rates. The model developed through this project can assist hydropower operators to maximize electricity generation (and revenue) while addressing environmental requirements in light of reduced stream flows due to a warming climate.

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

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$114,054

EPIC Funds Encumbered:

$650,000

EPIC Funds Spent:

$7,623

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $12,500,000

Leveraged Funds:

$12,500,000

Funding Method:

Non-competitive

Funding Mechanism:

Contract-Interagency agreement (Exempt)

No. of Initial Passing Applicants / Bidders:

N/A

Rank of Selected Applicant / Bidder:

N/A

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

This interagency agreement (non-competitive) leveraged significant federal funds.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The researchers have developed a hydropower optimization-modeling framework that considers institutional and physical constraints placed on hydropower operations. The modeling framework links energy and hydrologic models as well as permit requirements for hydropower facilities in the Upper San Joaquin, Merced, Tuolumne, and Stanislaus rivers under various climate change scenarios. To identify impacts at a scale relevant to facility operations, the researchers will create and run sequences of shorter climatic periods to replicate extended droughts and various combinations of wet and dry periods. This work is scheduled for completion by January 2020.

Project Name: 300-15-005 - Improving Hydrologic and Energy Demand Forecasts for Hydropower Operations with Climate Change

Recipient/Contractor: The Regents of the University of California, Irvine Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

The advancement of tools for hydropower scheduling and prediction will facilitate power exchanges in the electricity markets, reduce unnecessary consumption of non-renewable energy sources, and increase the reliability of energy generation. California will be the study region, helping inform California utilities in the management of hydropower resources.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

Applicable Metrics: CPUC Metrics- 3f, 5c

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

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$144,000

EPIC Funds Encumbered:

$720,000

EPIC Funds Spent:

$482,647

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $12,500,000

Leveraged Funds:

$12,500,000

Funding Method:

Non-competitive

Funding Mechanism:

Contract-Interagency agreement (Exempt)

No. of Initial Passing Applicants/ Bidders:

N/A

Rank of Selected Applicant / Bidder:

N/A

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

This interagency agreement (non-competitive) leveraged significant federal funds.

Treatment of Intellectual Property:

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

Update:

The research team is continuing work to develop short-term precipitation forecasting framework for key regions in California with a lead time of up to 6 hours. In addition, the team designed a new framework of deep forecasting neural networks Generative Adversarial Network (GAN) which will allow to forecast cloud-top brightness temperature (CTBT) and facilitate the generation of the spatial-temporal information that can be extrapolated for the future events. Furthermore, the project team is performing sensitivity analysis on the proposed Generalized Model Tree (GMT) framework. Researchers are currently testing multiple GMT algorithm settings for both benchmark data and real-case studies, and in early 2020 will identify the optimal algorithm for simulating rule-based hydrologic systems (such as reservoir release simulation and operating rule reconstruction).

Project Name: 300-15-006 - Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack Prediction

Recipient/Contractor: The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

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

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

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

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

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$198,000

EPIC Funds Encumbered:

$1,130,000

EPIC Funds Spent:

$395,443

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $12,500,000

Leveraged Funds:

$12,500,000

Funding Method:

Non-competitive

Funding Mechanism:

Contract-Interagency agreement (Exempt)

No. of Initial Passing Applicants/ Bidders:

N/A

Rank of Selected Applicant/ Bidder:

N/A

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

This interagency agreement (non-competitive) leveraged significant federal funds.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-15-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is on track. Critical Project Review meetings were conducted during the summer of 2019, with significant progress demonstrated in all research areas. The following are interim updates: a) market characterization study of non-traditional waters: preliminary literature review is complete and the team continues to assess sources of nontraditional waters for a full characterization. b) recycled water scenarios are complete and have been submitted for peer review; c) characterization of snowpack and snowmelt: preliminary results have been provided and are being shared amongst peers; d) the real-time snow-water-equivalent diagnostic models for the hydropower plants have been completed; e) for the desalination task, the team has completed tracking of bench scale membrane performance and continue to evaluate methods to improve membrane performance.

Project Name: 300-15-007, Project 1 - California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting (Tasks 1, 2, 3, 5 and 7)

Recipient/Contractor: California Clean Energy Fund dba CalCEF Ventures

Investment Plan: 2012-2014 Triennial Investment Plan, 2015-2017 Triennial Investment Plan

Project Term: 4/20/2016 to 3/1/2023

Program Area and Strategic Objective:

Applied Research and Development, Technical Support

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Smart grid: R.08-12-009 (closed) Smart Inverter: D.14-12-035 (in R.11-09-011) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3e

Economic Development: The CalSEED Initiative fills important niche in the energy innovation space by providing initial small grant funding to energy entrepreneurs to prove out their technology concept. The results can be used to attract private sector interest and funding for their energy technology venture.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,563,250

EPIC Funds Encumbered:

$33,000,000

EPIC Funds Spent:

$7,025,827

Match Partner and Funding Split:

California Clean Energy Fund dba CalCEF Ventures: $1,367,604 (4.1 %)

Elemental Excelerator: $100,000 (0.3 %)

The Grant Farm, Inc: $267,591 (0.8 %)

Los Angeles Cleantech Incubator: $1,040,000 (3.1 %)

Greenlining Institute: $68,700 (0.2 %)

Umberg Zipser: $552,328 (1.7 %)

Match Funding:

$3,396,223

Leverage Contributors:

U.S. Department of Commerce: $499,608

U.S. Department of Commerce: $250,000

Leveraged Funds:

$749,608

Funding Method:

Competitive

Funding Mechanism:

Contract

No. of Initial Passing Applicants/ Bidders:

5 out of 7 bidders

Rank of Selected Applicant/ Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, grants totaling over $5.5 million have been awarded to 29 entrepreneurs throughout the State for a range of projects including a battery electrode coating technology that is expected to lower the cost of lithium ion batteries by 35% while doubling the battery's life and a portable battery diagnostic system that can be embedded in an EV battery pack management system to continuously monitor battery health while detecting and preventing thermal runaway. In total, 71 entrepreneurs have been awarded $150,000 small grants under CalSEED. Ten Prototype Awards for an additional $450,000 each have been awarded under CalSEED — given as follow-on funding to CalSEED entrepreneurs whose technologies have the strongest impact and commercial potential. In total, CalSEED awardees have leveraged their grants to raise an additional $3.59M in follow on funding from public and private sources.

Project Name: 300-15-009 - Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities

Recipient/Contractor: Navigant Consulting, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan, 2015-2017 Triennial Investment Plan

Project Term: 6/13/2016 to 3/31/2021

Program Area and Strategic Objective:

Market Facilitation

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

Issue:

Emerging energy technologies sometimes fail to be commercialized because of difficulty entering the market, inability to find an optimal first customer, and inability to the address what end users actually want. To become viable in the market place, companies need market knowledge and support to develop products that meet customer needs, are cost competitive compared to existing products, and have viable path-to-market strategies that target appropriate early adopters.

Project Description:

This contract will provide market analysis that will address the barriers that hamper commercial development of emerging energy technologies. Tasks under this work authorization contract could include tracking past and current award EPIC technology solutions to monitor successes, more accurately consider future EPIC funding opportunities, inform technology gap analyses, and develop online resources. The deliverables from this project will help prioritize future Energy Commission funding towards technologies that solve the addressed issues.

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

This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Recommendations resulting from this agreement will help the Energy Commission better direct EPIC Program technologies towards addressing customer needs and becoming widespread, commercially available products.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 2a, 3e

Economic Development: Market research will provide information to develop technologies, or recommend use of technologies that meet customer needs that will move the technologies to market faster. Moving technologies to market enables job creation, improved business models, and market opportunities for technology developers.

Consumer Appeal: Market research will help better design products and research initiatives to address customer needs, increasing the attractiveness of these products in the marketplace.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$2,714,986

EPIC Funds Encumbered:

$6,937,889

EPIC Funds Spent:

$2,517,909

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Contract

No. of Initial Passing Applicants/ Bidders:

3 out of 4 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team has nineteen work authorization projects that are either active, in development, or have been completed. These work authorizations assist Energy Commission staff to appropriately target investments in microgrids, energy efficiency technologies, low-income/disadvantaged community research, and other topics. Additionally, a currently active work authorization has launched an online platform that facilitates tailored connections between investors, entrepreneurs, customer adopters and field test sites, and mentors and community based organizations. Over 400 members have joined the platform in the first two months since launch and they have been able to network with each other to form stronger proposal teams for Energy Commission and non-Energy Commission funding opportunities.

Project Name: 300-15-011 - California Commercial End-Use Survey

Recipient/Contractor: ADM Associates, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/15/2016 to 3/30/2021

Program Area and Strategic Objective:

Market Facilitation

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

Issue:

A commercial end-use survey (CEUS) is used by energy researchers, including the Energy Commission's Demand Analysis Office, to calculate estimates used in energy forecast models, including: commercial floor space, annual whole building energy use, end-use fuel saturations, and annual whole-building hourly load profiles. Researchers at universities and national labs have indicated interest in having energy-use forecasts with more granularity, disaggregated to the local or regional service territory level. The end-use survey must be properly designed to fully support this level of granularity in order to increase the confidence of the results, and thus, the accuracy of the energy forecasts.

Project Description:

The Energy Commission conducted a CEUS in 2006, since then the energy landscape in California has changed dramatically including the deployment of advanced energy efficiency and renewable generation technologies. This project is updating the CEUS while adding additional granularity by (1) developing a methodology to conduct a survey of the characteristics of commercial utility customers that will serve as a baseline and support the Energy Commission's work on the demand forecast, (2) implementing the survey, and (3) providing an unbiased, comprehensive analysis of the data. When completed, the CEUS will provide a clearer picture of commercial energy end-use which will allow better strategic targeting of policies and incentives which will help facilitate the commercial success and market adoption of technologies, strategies, and other innovations.

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

The CEUS will provide a more disaggregated sampling of the state's end-uses in the commercial sector, than was historically collected. This level of granularity will lead to more accurate energy forecasts which can assist in keeping rates low as forecasts are used to determine infrastructure needs in long term procurement planning by the CPUC. Furthermore, the data can assist the state in achieving the energy efficiency reduction goals outlined in Senate Bill 350 by supporting the identification and accurate

characterization of opportunities for demand-side management, energy efficiency program planning, load shifting, and demand response.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 (closed) Long-Term Procurement Proceeding (LTPP): R.13-12-010 (closed)

Applicable Metrics: CPUC Metrics- 1c, 2a, 5c

Lower Costs: This project can support reduced costs by leading to a more accurate demand forecast for the commercial sector. This can provide more certainty on base-line end-use consumption and provide a better input into the CPUC's Long-Term Procurement Planning efforts so that only the generation that is truly needed will be planned and procured.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$3,426,324

EPIC Funds Encumbered:

$7,990,063

EPIC Funds Spent:

$4,686,891

Match Partner and Funding Split:

ADM Associates, Inc.: $100,893 (1.2 %)

Match Funding:

$100,893

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Contract

No. of Initial Passing Applicants / Bidders:

4 out of 4 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-15-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, ADM continued data collection throughout the state. By the end of the year, more than 17,000 sites had been surveyed, of which approximately 15,400 were in IOU electric service territories. During this time, ADM continuously worked to refine the quality control procedures to minimize issues with the data collection process. This included developing new automated procedures for field surveyors to identify incorrect values in the data, and updating the Research Plan to reflect the changes in protocol. The team will work to finalize data collection in the IOU electric service territories, and submit the EPIC final report, by March 2020.

Project Name: 300-17-003 - Distributed Energy Resources (DER) Roadmap

Recipient/Contractor: Navigant Consulting, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/29/2018 to 9/30/2020

Program Area and Strategic Objective:

Market Facilitation

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

Issue:

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

Project Description:

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

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

This project will inform the strategic and effective targeting of future EPIC investments to maximize the use of public research and development investments. The resulting roadmap will identify and prioritize research on the most critical RDD&D technology gaps to enable transformation of the grid to increasingly integrate DERs. The results of the analysis will provide further detail in the integration into utility planning and operational policies that are critical to the technological improvements and physical connections to the grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

Applicable Metrics: CPUC Metrics- 2a

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

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$242,382

EPIC Funds Encumbered:

$499,065

EPIC Funds Spent:

$261,845

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Contract

No. of Initial Passing Applicants/ Bidders:

5 out of 5 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

Navigant completed the DER Technical Assessment in April 2019. Three public workshops were held on March 25, July 25, and September 17, 2019. The first workshop provided information on the publicly released DER Draft Technical Assessment and solicited feedback from stakeholders on the status of DER technologies and strategies today and the barriers currently limiting DERs. The second workshop introduced a prioritization methodology to rank potential DER research needs and also solicited input from stakeholders to better characterize the status of DER technologies and strategies, and to identify barriers to efficient integration. The third workshop summarized the research ideas submitted, discussed the screening process, and presented the preliminary scores and ranks of the research ideas.

Project Name: 300-17-004 - Measuring Innovation Progress to Guide Future Investment: Evaluation of EPIC Benefits Methodology

Recipient/Contractor: Industrial Economics, Incorporated

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/29/2018 to 2/16/2021

Program Area and Strategic Objective:

Market Facilitation

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Applicable Metrics: CPUC Metrics- 3e

Economic Development: This project will help the Energy Commission better understand the benefits to ratepayers resulting from projects funded by the EPIC program and will help the Energy Commission make more efficient and effective use of future EPIC funds.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,716,826

EPIC Funds Encumbered:

$3,000,000

EPIC Funds Spent:

$1,646,302

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Contract

No. of Initial Passing Applicants / Bidders:

3 out of 3 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the

recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project has completed a characterization of the EPIC program portfolio and provided recommended methods for evaluating EPIC's benefits to ratepayers. The project team is currently working with EPIC research area leads to develop research-area specific benefits methodology. The project team is developing tools on a rolling basis when approved by EPIC staff. EPIC staff are starting to receive and pilot test draft methodologies and tools.

Project Name: 300-17-005 - Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation

Recipient/Contractor: Energetics Incorporated

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/4/2018 to 5/29/2020

Program Area and Strategic Objective:

Market Facilitation

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

Issue:

This Research Roadmap initiative arises from the need to help achieve California's forward-leaning, legislated goals to increase energy efficiency, ramp up the generation of renewable power, and reduce emissions contributing to global climate change. Therefore, EPIC requires an RD&D portfolio that strategically targets a mix of scientific and technological advancements, sets and meets appropriate milestones, and leverages available resources to accelerate the delivery of effective products and practices. Broad market uptake of these new technologies is essential to attain state energy and environmental goals.

Project Description:

This project aims to develop a research roadmap to strategically frame research priorities, potential partnerships, and critical technology milestones to support EPIC portfolio decisions and accelerate progress toward more cost-competitive, flexible and reliable renewable energy generation, operation, and storage.

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

This Research Roadmap aims to strategically frame research priorities, potential partnerships, and critical technology milestones to help inform EPIC research development, demonstration, and deployment (RDD&D) portfolio decisions and accelerate progress toward more cost competitive, flexible and reliable renewable energy generation, operation, and storage. A roadmap is an effective tool for laying out RDD&D pathways. A robust roadmap considers a spectrum of technology complexity, the current state of the art, rapid expansion of scientific knowledge, competition for RDD&D funding, dynamic customer expectations, and the cost and risk of research.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

Applicable Metrics: CPUC Metrics- 2a

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$86,365

EPIC Funds Encumbered:

$338,059

EPIC Funds Spent:

$167,195

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Contract

No. of Initial Passing Applicants / Bidders:

4 out of 4 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

The team conducted interviews and webinars with experts to prepare a preliminary draft for public discussion. The public discussion was conducted as a webinar to request public comments on the research and development opportunities identified for the research roadmap on renewable energy generation technologies for utility-scale applications. The team collected over 75 comments and developed a Yes/No process for prioritizing comments received from Public Webinar. Subject matter experts engaged to contribute to the Yes/No process and helped determine which initiatives would change from the preliminary draft discussed on the webinar. The project team started drafting the roadmap which will be presented at a public webinar at the beginning of 2020.

Project Name: 300-18-001 - Technology Transfer for EPIC Research Projects

Recipient/Contractor: Gladstein, Neandross & Associates LLC

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/10/2019 to 3/31/2022

Program Area and Strategic Objective:

Market Facilitation

S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

It is important to make the results from publicly-funded research and development projects publicly available to accelerate the development and adoption of new, clean energy technologies. Technology transfer activities ensure that these publicly-available results are effectively disseminated to energy stakeholders, including investors, technology developers, customers, local governments and policymakers; who can act upon these results to accelerate commercialization of new energy technologies. To be successful requires a team with expertise in the energy sector as well as a proficiency in developing web materials and conducting forums to bring the right stakeholders and experts together.

Project Description:

The purpose of this Agreement is to fund technology transfer services to ensure that the results of EPIC-funded projects are effectively disseminated and communicated to stakeholders. The contractors will work closely with Energy Commission staff to: 1) develop and implement a digital technology transfer strategy for EPIC, including redesigning and increasing the functionality of the Energy Commission-owned Energy Innovation Showcase website to improve its effectiveness and usefulness as a technology transfer tool; 2) conduct up to nine topical forums across the state, discussing key issues affecting the electricity sector; and 3) plan, produce, and manage two EPIC Symposium events.

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

This Agreement will lead to increased benefits for EPIC ratepayers by accelerating the development and deployment of new emerging clean energy technologies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Self-Generation Incentive Program: R.12-11-005 Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Distribution Resources Plans (AB 327): R.14-08-013 Smart Inverter: D.14-12-035 (in

R.11-09-011) SB 1122 Bioenergy feed-in tariff: R.11-05-005 Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 California Solar Initiative: R.12-11-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007 Identify Disadvantaged Communities in the San Joaquin Valley and Provide Economically Feasible Options for Affordable Energy: R.15-03-010 Strategies and Guidance for Climate Change Adaptation: R.18-04-019 Renewables Portfolio Standard Program: R.18-07-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 2a

Consumer Appeal: By disseminating the results of EPIC-funded projects more frequently and in a more efficient manner, customers can become familiar with products more quickly which can lead to faster deployment of new technologies and an increase in consumer appeal.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$881,903

EPIC Funds Encumbered:

$3,788,265

EPIC Funds Spent:

$19,738

Match Partner and Funding Split:

Larta Institute: $115,372 (2.3 %)

Sensis Agency: $22,889 (0.4 %)

Gladstein, Neandross & Associates LLC: $1,172,307 (23.0 %)

Match Funding:

$1,310,568

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Contract

No. of Initial Passing Applicants / Bidders:

5 out of 6 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement 300-18-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Kicking off in August, the team immediately began work, setting up a shared project management website and holding weekly calls with staff. The team formed two groups to conduct work in parallel for 1) event planning for the 2020 EPIC Symposium and technical forums, and 2) the new project website. For most of 2019, they worked with staff to draft topics and agendas for technical forums, as well as plan all aspects for the 2020 symposium. Branding and themes for event marketing collateral was also developed. After conducting extensive customer discovery and learning about the state's IT requirements, the team submitted a digital technical transfer strategy for approval, which helped inform the development of wire frames for the project website. In 2020, the team will hold at least three technical forums, a two-day symposium planned for April, and complete development of the website.

Project Name: EPC-14-002 - Investigating Flexible Generation Capabilities at the Geysers

Recipient/Contractor: Geysers Power Company, LLC

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 1/5/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Electric system operators need solutions to effectively manage large quantities of intermittent energy sources and maintain grid reliability. While geothermal energy has served to provide a steady level of baseload energy, reducing impacts of intermittent energy will require quickly dispatchable sources of generation with the flexibility to ramp up or down as needed. Modifying geothermal operations to provide this flexibility would be valuable to system operation but requires overcoming physical and operational issues.

Project Description:

This project seeks to expand flexible generation capabilities of The Geysers geothermal facilities and support electrical grid reliability. The current operational configuration of The Geysers were thoroughly evaluated through modeling and field testing to determine ways to expand flexible generation capabilities. Steam field and power plant equipment were modified and tested in various load cycling scenarios to determine operating capabilities and limitations of equipment to achieve flexible generation while avoiding or minimizing any potential damage to facilities. The project team concluded that individual Geysers power plants can operate in a flexible or cyclic operating mode down to their existing minimum generating operating limits. However, when multiple power plants are in cyclic operating mode at the same time, operators were challenged by the required monitoring and related manual adjustments.

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

The technical and economic benefits of this study will come from expanding the flexible generation capabilities of The Geysers generation facilities to maintain grid reliability and help support additional variable renewables to meet the state's RPS goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: Geothermal power plants support resource adequacy and RPS goals, voltage support, and scheduled reactive power. This study has shown that Geysers geothermal resources have the potential to contribute significant flexible capacity to the California electrical grid.

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$3,000,000

EPIC Funds Spent:

$2,822,000

Match Partner and Funding Split:

Geysers Power Company, LLC: $1,615,560 (21.9 %)

Multiple Mechanical Subcontractors: $2,071,190 (28.1 %)

Multiple Equipment Suppliers: $659,223 (9.0 %)

Reservoir Engineering Contractor: $16,400 (0.2 %)

Match Funding:

$4,362,373

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

18 out of 18 bidders

Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project conducted a study to investigate flexible electrical generation capabilities at The Geysers. The modeling work performed in this project resulted in successful development and application of a simulation-optimization framework for the optimal control of the steam field under load curtailment. Upgrades installed during this study removed turbine related constraints, made it feasible to achieve rapid cutbacks using existing ramp rates, and provided an incremental increase in existing flexible generation capabilities. Field-testing and modeling results show that steam well and pipeline corrosion is a major constraint on steam-field operations. However, results from this study will guide economic evaluations and future capital improvements needed to expand the flexible generation capabilities at The Geysers.

Project Name: EPC-14-003 - Low- Cost Thermal Energy Storage for Dispatchable CSP

Recipient/Contractor: The Regents of the University of California on behalf of the Los Angeles Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 1/15/2015 to 3/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

With an increasing share of electricity generation coming from variable renewable energy resources such as wind and solar, new strategies are needed to ensure that electricity supplies can effectively match demand. One such strategy is to use thermal energy storage (TES) with concentrating solar power (CSP). However, this technology is currently prohibitively expensive and difficult to dispatch.

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

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

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

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

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$198,528

EPIC Funds Encumbered:

$1,497,024

EPIC Funds Spent:

$1,205,642

Match Partner and Funding Split:

Southern California Gas Company: $300,000 (16.7 %)

Match Funding:

$300,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

18 out of 18 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project performed detailed heat transfer modeling and simulation, laboratory-scale material compatibility experiments, and laboratory-scale thermal battery testing. Results from the laboratory-scale (10 kWh capacity) system were very promising. The system was successfully operated at high temperature (600 degrees Centigrade) over multiple thermal cycles and demonstrated higher energy density and faster dynamic response (speed of charge and discharge) compared to conventional molten salt technology. A pilot-scale (30 kWh capacity) thermal battery system was designed, built, and field tested with CSP in December 2018. Testing the system in a real-world environment validated performance with actual solar energy input and provided valuable validation of system-level analysis and heat transfer tools. Researchers are now scaling up the techno

Project Name: EPC-14-008 - High-Fidelity Solar Power Forecasting Systems for the 392 MW Ivanpah Solar Plant (CSP) and the 250 MW California Valley Solar Ranch (PV)

Recipient/Contractor: The Regents of the University of California, San Diego

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 1/15/2015 to 1/15/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

This project introduced a new generation of forecasting methods that fill in a technology gap in the prediction of DNI and POA irradiance as well as solar power generation from PV tracking and CSP. This critical need is evident by the relative scarcity of DNI forecasting algorithms discussed in the scientific literature and the absence of DNI information from the majority of numerical weather prediction models. The development of a network of low-cost sensors for distributed monitoring at California Valley Solar

Ranch (CVSR) provides a solution to the need for high-density ground telemetry at low cost. The devices provide an unprecedented level of irradiance sensor density. Forecasting research not only enhances the ability of power plant managers, utility companies and the California ISO to reduce solar costs to ratepayers, but it can also enable higher penetration of renewables.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) California Solar Initiative: R.12-11-005

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

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

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

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

Environmental Benefits: The project will result in GHG emission reductions by decreasing the uncertainty associated with solar power generation and diminishing the need of fossil fuel-based generation.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$168,624

EPIC Funds Encumbered:

$999,898

EPIC Funds Spent:

$998,828

Match Partner and Funding Split:

NRG Energy, Inc.: $460,000 (26.1 %)

Itron, Inc. dba IBS: $304,019 (17.2 %)

Match Funding:

$764,019

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

18 out of 18 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project demonstrated that the forecasting accuracy for DNI and POA irradiance across all time-scales (intra-hour, intra-day, day-ahead) can be improved using forecasting models that blend local and remote telemetry. The project results demonstrated the importance of having a rich set of input data to improve forecasting. This conclusion was more pronounced for the intra-hour time scale, in which multiple solar sensor data -- including sky images and high-resolution satellite images -- are essential to reduce forecasting errors. The tools developed were used in two very distinct testbeds (Ivanpah and CVSR) to predict irradiance and power generation. In both cases, the forecasting accuracy was improved relative to baseline models. The models were successfully applied to other locations, showing that they can be used in other grid-connected solar farms.

Project Name: EPC-14-009 - Optimizing Radiant Systems for Energy Efficiency and Comfort

Recipient/Contractor: The Regents of the University of California on behalf of the Berkeley campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Radiant heating and cooling systems deliver or absorb heat through a building's surface. Application of radiant systems has increased in recent years as they provide an opportunity to (1) achieve energy and peak demand savings compared to conventional all-air systems, (2) eliminate duct losses, and (3) circulate less allergens. Despite this growth, operation of radiant systems can be challenging due to a lack of familiarity within HVAC design and operation professions because there is limited guidance and inappropriate tools to assist designers and building operators. New and/or revised definitions and methods for the design, sizing, and control of effective radiant systems are needed.

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: The technology could reduce energy consumption and costs in California commercial buildings by as much as 1.352 GWh/yr and $192M/yr.

Environmental Benefits: The technology could reduce CO2e emissions due to reductions in energy use for cooling California commercial buildings. Based on the estimated annual electric savings, implementation of radiant systems could reduce CO2e emissions by up to 360,000 metric tons.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$450,466

EPIC Funds Encumbered:

$2,939,964

EPIC Funds Spent:

$2,774,084

Match Partner and Funding Split:

Center for the Built Environment - UC Berkeley: $239,194 (7.4 %)

Price Industries: $60,000 (1.9 %)

Match Funding:

$299,194

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is complete. The recipient developed: sizing and operation tools to provide reliable methods to calculate energy performance of radiant systems while maintaining comfort, energy, cost, and comfort data to provide real world examples of energy efficient, affordable, and comfortable buildings using radiant systems, and recommendations for Title-24 and ASHRAE Standards advancements. The research team used full-scale laboratory experiments, whole-building energy simulations and tool development, and field studies and control demonstrations to develop guidance and tools to help the building industry adopt radiant systems. Recommendations for revisions to relevant codes and standards will continue to be communicated to the responsible organizations by the research team, who regularly participate in committees and conferences related to Title-24 and ASHRAE

Project Name: EPC-14-011 - From the Laboratory to the California Marketplace: A New Generation of LED Lighting Solutions

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/1/2015 to 3/19/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The LED products developed could result in direct electricity and peak demand reduction and cost savings for consumers by an estimated 30%. Recipient estimates that products developed as a result of this project could reduce electricity costs by 8,000 GWh annually. For residential ratepayers, the products developed under this award will help reduce lighting electricity consumption in the morning and evening hours, hours which see the highest use among residential customers. Similarly, for commercial ratepayers, the products developed under this agreement will result in direct peak demand reductions and cost savings

Environmental Benefits: As lighting constitutes 20-30 percent of the electrical use in buildings, the development and deployment of the developed LED products could reduce electricity use and CO2 emissions.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$557,072

EPIC Funds Encumbered:

$2,995,187

EPIC Funds Spent:

$2,826,674

Match Partner and Funding Split:

Regents of the University of California, Davis - California Lighting Technology Center: $5,000 (0.2 %)

Match Funding:

$5,000

Leverage Contributors:

California Lighting Technology Center - UC Davis: $5,000

Leveraged Funds:

$5,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Widespread adoption of LED lighting for general illumination applications is one of the largest advances in lighting building efficiency. However the focus on cost reductions at the expense of product quality has led to a lack of consumer satisfaction, and minimal market share for LED products in residential and commercial applications. This project designed and developed novel, energy-efficient, LED lighting solutions with quality and performance features that align with consumer expectations. Key research outcomes include: proposed changes to ANSI LED color bins to address consumer expectations, documented consumer preferences for color fidelity, quantification of the impact of color fidelity on visual acuity, and consumer preferences for lighting product packaging and information. These outcomes informed product specifications for linear LED lamps, retrofit kits and luminaires

Project Name: EPC-14-013 - Very Low-cost MEMS-based Ultrasonic Anemometer for Use Indoors and in HVAC Ducts

Recipient/Contractor: The Regents of the University of California on behalf of the Berkeley campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 8/25/2015 to 3/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

The ability to accurately control airflow with these low cost sensors can expand the comfortable temperature setpoint range in air-conditioned buildings, such as allowing the setting higher indoor temperatures while still being comfortable. Based on industry feedback, the most promising application is to incorporate the sensors into HVAC system. Assuming a 15 percent market penetration for applications, and a 10 percent penetration for retrofit the estimated total statewide savings could be 265 gigawatt hours per year and 38 million therms per year, based upon an estimated level of market penetration 10 years.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The prototype uses very low power to operate and is less expensive than products currently on the market. The estimated cost to produce at volume is under $200 (compared with over $1,000 from other vendors). The anemometer uses very low power to operate. The estimated savings to California commercial and residential ratepayers are $26 million per year in reduced energy bills for building owners/occupants, assuming technology applicability in 25-75% of buildings, a 10-15% potential savings on all HVAC related energy use, and market penetration of 5-25%. Due to potentially less equipment operation time, equipment life could be extended along with reduced operations and maintenance cos

Increase Safety: Safety of occupants is improved when ventilation air is accurately measured, as inaccurate measurements often lead to insufficient ventilation to the occupants.

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

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$214,202

EPIC Funds Encumbered:

$2,488,964

EPIC Funds Spent:

$2,462,263

Match Partner and Funding Split:

Price Industries: $40,000 (1.5 %)

BAF Technologies Inc.: $45,000 (1.6 %)

Chirp Microsystems, Inc.: $120,000 (4.4 %)

Center for the Built Environment - UC Berkeley: $14,000 (0.5 %)

Vigilent: $30,000 (1.1 %)

Match Funding:

$249,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project has completed and the final report is under review. The recipient produced a prototype anemometer that is disruptively low cost, calibration free, accurate and uses low energy. A number of manufacturers may be interested in the ultrasonic technology and a provision patent was filed through University. A major control manufacturer signed a Non-Disclosure Agreement. The agreement laid the groundwork for further commercial development. The recipient continues to engage with potential manufacturers.

Project Name: EPC-14-017 - Developing Flexible, Networked Lighting Control Systems That Reliably Save Energy

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/1/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The technology could reduce energy consumption and costs associated with lighting energy use in commercial buildings by an estimated 60 to 80 percent. Additionally, one of the goals is to develop low cost lighting components which could facilitate easier implementation into the marketplace.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$216,162

EPIC Funds Encumbered:

$1,875,000

EPIC Funds Spent:

$1,875,000

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 6

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

This project developed a suite of networked lighting solutions to reduce lighting energy use in buildings: a) a low-cost sensing, distributed intelligence and communications platform, the "PermaMote," b) a task ambient daylighting system that integrates sensors with data-driven daylighting control using an open API, c) a new method for evaluating and specifying lighting systems' performance, d) a proposed lighting data model and user interface elements, which contributed to the ANSI Lighting Systems Committee (C137), and e) a metric for capturing the actual energy impact of a lighting system over time. Laboratory validation of the technologies showed significant energy savings, up to 73% for the PermaMote sensor system. These advanced technologies can reduce California commercial-building lighting energy use by 60-80% or about 1,500 GWh/year in savings.

Project Name: EPC-14-021 - Development and Testing of the Next Generation Residential Space Conditioning System for California

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 (closed)

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

Lower Costs: This technology is estimated to reduce electricity usage by 475 GWh per year, or approximately $83 million annually. In addition, the fault detection and diagnostic feature could help reduce operation and maintenance costs on HVAC equipment.

Greater Reliability: The technology is estimated to reduce peak demand by 1 to 1.5 GW which could reduce impacts to the grid.

Environmental Benefits: The technology is estimated to reduce greenhouse gas emissions by 157,000 metric tons of CO2 emissions annually due to reductions in energy use.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,072,105

EPIC Funds Encumbered:

$2,993,005

EPIC Funds Spent:

$2,981,202

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $322,281 (9.7 %)

Match Funding:

$322,281

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 8

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has been completed. The recipient developed a residential space conditioning system that integrates advanced HVAC technologies including: a variable capacity compressor and blower, automated demand response, fault detection and diagnostics, intelligent dual fuel heating, integrated ventilation, and zonal control. An alternative refrigerant, R-32, was evaluated as a possible future enhancement. An assessment was performed on duct losses for single versus multi-zone duct configurations with variable capacity equipment. The report find that the system could potentially save 22-32% of cooling energy compared to a 14 SEER single speed system, as well as satisfying over 90% of annual heating load for most of California without electrical or natural gas back-up. Daikin/Goodman, the product's manufacturer, will take the project results to consider iterations of their future products.

Project Name: EPC-14-022 - The Lakeview Farms Dairy Biogas - To - Electricity Project

Recipient/Contractor: ABEC #3 LLC, dba Lakeview Farms Dairy Biogas

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

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

Project Description:

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

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

The project will significantly reduce methane emissions and generate renewable electricity, helping to achieve the state's greenhouse gas emission reductions and renewable electricity goals. Demonstrating the effectiveness of the innovative hub and spoke model could lead to the development of more California dairy digester biogas-to-

electricity and biogas-to-fuels projects. The improved digester design will decrease dairy operating costs and provide valuable co-products, such as nutrient-rich irrigation water.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

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

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

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$29,498

EPIC Funds Encumbered:

$4,000,000

EPIC Funds Spent:

$3,951,593

Match Partner and Funding Split:

ABEC #3 LLC, dba Lakeview Farms Dairy Biogas: $4,500,000 (52.9 %)

Match Funding:

$4,500,000

Leverage Contributors:

California Department of Food and Agriculture: $2,000,000

Leveraged Funds:

$2,000,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 23 bidders

Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

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

Update:

The project broke ground in fall 2016 and construction was completed. The project accepted a PG&E 20-year Power Purchase Agreement and began testing in the fourth quarter 2017, with full operation and data collection commencing in the first quarter of 2018. A ribbon-cutting event was held in February 2018. The project has been operating and has collected operational data for one year. Electrical production from the digester exceeded expected production during 2018. Annual electrical production was more than 1,500 kilowatt-hours per milk cow equivalent. The project was completed in March 2019.

Project Name: EPC-14-023 - Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits

Recipient/Contractor: Eos Energy Storage, LLC

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/27/2015 to 8/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

The purpose of this agreement is to fund the development of an emerging energy storage technology, a zinc hybrid cathode battery (Znyth), and demonstrate the performance of this technology for distribution-connected applications in partnership with a utility. Eos has been selected by Pacific Gas and Electric (PG&E) under the AB 2514 Energy Storage Mandate Procurement to provide a 10MW/40MWH system in 2020. The test results of this grant are important to keep this larger utility commercial procurement on schedule. They are also valuable to the CPUC to demonstrate alternatives to Li-ion storage for distribution applications.

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1c, 1i, 2a, 4a, 5b

Lower Costs: This project will determine any cost savings by testing this battery system and determining how well the battery can cost-effectively provide the grid with peak shaving, ancillary services, load following, and frequency regulation. These markets and services may provide a revenue stream for energy storage users.

Greater Reliability: This project will contribute to more efficient battery storage which will ensure greater reliability for the grid as a whole and increase energy storage use.

Increase Safety: This zinc-based battery technology is safer than competing technologies because it is non-flammable and non-toxic. The manufacturing process does not involve toxic or hazardous materials; this also makes transportation and handling much safer.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$691,504

EPIC Funds Encumbered:

$2,156,704

EPIC Funds Spent:

$1,927,382

Match Partner and Funding Split:

Eos Energy Storage, LLC: $1,117,607 (33.6 %)

Electric Power Research Institute, Inc.: $50,000 (1.5 %)

Match Funding:

$1,167,607

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

35 out of 38 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

Due to unforeseen circumstances in early 2019, Eos was unable to continue testing the Generation 2 system with PG&E in San Ramon. Instead, Eos found a new utility test partner and test site with SDG&E in Pala, San Diego County. Eos is working with SDG&E to conduct the testing originally planned with PG&E. In October, preparations began for installation, commissioning, testing and evaluation of the Generation 2 system at SDG&E's Playa del Norte site and testing will continue through the middle of 2020. A draft final report has been completed and is currently under revision.

Project Name: EPC-14-025 - Mass-manufactured, Air Driven Trackers for Low Cost, High Performance Photovoltaic Systems

Recipient/Contractor: Sunfolding Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/1/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

California Solar Initiative: R.12-11-005

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

Lower Costs: Sunfolding's tracker drives down project costs, lowers LCOE, and improves project profitability. On a 100 MW site, Sunfolding's team estimated a 20 percent improvement in LCOE over traditional trackers. The modular design enables flexible site layouts with a tracker that fits into odd-shaped sites, which can add up to 20% more capacity on a site. This significantly lowers fixed costs. Traditional trackers use more than 21 components while Sunfolding's tracker uses only three. By using fewer components, the system is installed 2x faster and with less chance for re-work or error.

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$157,497

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$989,116

Match Partner and Funding Split:

PV Evolution Labs: $265,000 (12.2 %)

Sunfolding, Inc.: $906,565 (41.7 %)

Match Funding:

$1,171,565

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team successfully installed and tested the 300kW PV tracking system in the field. The site was instrumented with sensors, cameras, and data collection equipment. The team installed distributed position sensors to gather temporal positioning and providing tracker consistency data, high accuracy air pressure sensors to assess pneumatic performance, and a video monitoring system to enable remote visual monitoring. The team collected data for more than six months and concluded that the system exceeded expectations in tracker performance, accuracy, and uptime. The team developed several generations of the actuator over the life of the project, which did not experience component failures during the demonstration activities. EPIC funding was critical to advancing Sunfolding's commercialization efforts, allowing to build a track record and establish reliability and bankability.

Project Name: EPC-14-028 - Low Cost Biogas Power Generation with Increased Efficiency and Lower Emissions

Recipient/Contractor: InnoSepra, LLC

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/1/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Conventional biogas purification technologies used for biogas upgrading have high capital and operating costs, and have not been used commercially in power generation applications. Innovative technologies and physical sorbents to effectively remove multiple impurities from raw biogas in a single step prior to power generation would enable a significant reduction in the capital and operating costs and energy required for biogas purification. The use of purified biogas for power generation can provide significant cost, efficiency, and environmental benefits in combined heat and power generation applications.

Project Description:

This project deployed a pre-commercial technology demonstrating a sorbent-based biogas purification process for combined heat and power generation at the pilot scale that removes multiple troublesome impurities from biogas, upgrading the fuel to near-pure methane for combustion in conventional prime movers. The pilot plant was installed and tested at a landfill site to demonstrate the environmental and cost benefits of biogas purification prior to use in combined heat and power applications.

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

The project is advancing an innovative gas clean-up system based on a temperature swing adsorption concept that adsorbs carbon dioxide and other contaminants while letting methane pass through and that regenerates the adsorbent bed, resulting in lower cost of operation. Converting biogas to high purity biomethane enables its use in premium efficient devices for power generation, thereby helping reduce the cost of electricity. This technological approach will help meet renewable electricity goals at a lower cost and will enable use of marginal biogas sources for power generation applications using conventional natural-gas fired prime movers.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Self-Generation Incentive Program: R.12-11-005 SB 1122 Bioenergy feed-in tariff: R.11-05-005 Combined heat and power: D.10-12-035., R.08-06-024. (closed)

Applicable Metrics: CPUC Metrics- 1a, 1b, 3g, 4a, 4b

Lower Costs: This project is expected to lower costs by reducing the number of stages required to condition biogas to meet fuel specifications of most prime movers.

Environmental Benefits: The project will reduce carbon dioxide emissions by increasing the use of renewable fuel and replacing fossil-derived methane for electricity generation. The project will also result in fewer methane emissions by reducing the flaring of biogas into the atmosphere.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$105,570

EPIC Funds Encumbered:

$1,318,940

EPIC Funds Spent:

$1,236,591

Match Partner and Funding Split:

InnoSepra, LLC: $930,000 (40.8 %)

ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.: $11,000 (0.5 %)

Waste Management of California, Inc: $18,150 (0.8 %)

Match Funding:

$959,150

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-existing: U.S. Pat 8,591,627, 26 Nov 2013; U.S. Pat Appl 2014002675, 26 Sept 2013 Application number and date: Process for Upgrading Gases Containing Methane, to be filed in Feb 2015

Update:

InnoSepra's gas conditioning system was upgraded and delivered to the Simi Valley landfill in September, 2018. The system has been functioning as designed, and the project team has focused on accumulating hours of operation. InnoSepra was unable to make a second deployment at a digester site due to time constraints. The outcome at the landfill site shows that the absorption process is capable of upgrading landfill gas with up to 200 ppm hydrogen sulphide to renewable natural gas. Economic modeling suggests that the temperature swing regeneration will reduce process power consumption by 50%, resulting in significant cost reduction compared to alternative processes (amine absorption, membranes, pressure-swing absorption).

Project Name: EPC-14-029 - The West Star North Dairy Biogas-to -Electricity Project

Recipient/Contractor: ABEC #2 LLC, dba West Star North Dairy Biogas

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

Despite a regulatory environment encouraging renewable energy production and greenhouse gas reductions, dairy digester development has lagged in California. Fewer than twenty dairies in California have installed digesters and roughly half of these projects are operating. With dairy digesters having the potential to play an important role in providing renewable baseload electricity as well as reducing California's greenhouse gas emissions, California needs to demonstrate projects, including the design, operation, and management strategies that can drive successful dairy digester-to-electricity projects.

Project Description:

This project advances digester design by building and demonstrating an innovative, double-cell covered lagoon digester and 1-megawatt (MW) generation system. The system will convert dairy manure into biogas and store the biogas above the primary and secondary lagoons under an inflatable cover. The biogas will be converted into renewable electricity and sold for export to the PG&E distribution grid. Further, dairy biogas systems qualify for participation in the CPUC's Assembly Bill (AB) 2514 electricity storage program. In a future phase, the biogas system may compete for an energy storage contract. The project will also improve groundwater protection by minimizing leaching of manure into the groundwater.

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

This project demonstrates an improved digester design with a double cell lagoon for greater biogas storage and on-demand generation potential and, if successfully scaled up, establishes dairies as competitors for storage contracts. The improved system will decrease dairy and digester operating costs while also enhancing the protection of groundwater. Other important benefits include: lowered manure handling costs and valuable co-products, such as nutrient-rich irrigation water.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: By advancing digester economics and design as well as efficient manure management practices, the project will help lower dairy management and operation costs.

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

Consumer Appeal: The project will improve odor control, through hydrogen sulfide removal, which is important to the dairy employees and benefits the local community.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$32,107

EPIC Funds Encumbered:

$4,000,000

EPIC Funds Spent:

$3,998,164

Match Partner and Funding Split:

ABEC #2 LLC, dba West Star North Dairy Biogas: $5,000,000 (55.6 %)

Match Funding:

$5,000,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 23 bidders

Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Bioenergy Storage and Management System and Method.

Lagoon Digester with Flexible Volume Capability.

California Bioenergy LLC Lagoon Digester Systems.

Update:

The project broke ground in fall 2016 and construction is complete. The project accepted a 20-year PG&E BioMAT Power Purchase Agreement and is collecting data, with full operation commencing in the first quarter of 2018. The project has collected operational data for a full year. The data collection system built into this digester and engine-generator system will be valuable in operating the digester technology. The project was completed in March 2019.

Project Name: EPC-14-030 - Paths to Sustainable Distributed Generation Through 2050: Matching Local Waste Biomass Resources with Grid, Industrial, and Community Levels

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/15/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

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

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Combined heat and power: D.10-12-035., R.08-06-024. (closed)

Applicable Metrics: CPUC Metrics- 3c, 4a

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

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$670,276

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$1,500,000

Match Partner and Funding Split:

Energy Bioscience Institute: $50,000 (2.8 %)

Allotrope Partners: $200,000 (11.2 %)

PepsiCo R&D: $32,000 (1.8 %)

Match Funding:

$282,000

Leverage Contributors:

United States Department of Energy: $900,000

Leveraged Funds:

$900,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

The project team developed 2020 (near-term) and 2050 (long-term) scenario projections for waste biomass supply in California. They also developed a county-level monthly wet and dry California biomass inventory and assessed the energy generation potential from food waste in California. The team has estimated energy demand density and identified areas with district heating and cooling potential by using a building stock turnover model along with energy use intensity factors. The project developed a biositing tool for evaluation of potential waste-to-energy sites based on resource availability, potential for waste heat use, and economic and environmental metrics. The project was completed in March 2019. The information that is available, e.g. biositing is a web-based tool, and various biomass associations, project developers and other stakeholders plan to use it.

Project Name: EPC-14-031 - Pollution Control and Power Generation for Low Quality Renewable Fuel Streams

Recipient/Contractor: The Regents of the University of California on behalf of the Irvine Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/1/2015 to 3/31/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

Many potential renewable fuel streams cannot be used to generate electricity using current technology without considerable upgrading (i.e., increasing the heating value) and substantial clean up (e.g., cleaning contaminants such as hydrogen sulfide or siloxanes introduced by the feedstock). Prime examples include landfills that are approaching end of life that produce gases with some heating value, but the values are generally too low for commonly used combustion devices (e.g., reciprocating engines, gas turbines). Landfill biogases are also often challenging due to the variability in the level of contaminants.

Project Description:

The project proposed to use a 250 kW gas turbine system that converts relatively dirty, low heating value fuels into heat using gradual oxidation. This gradual oxidation technology was developed by Ener-Core, a California company, and has been demonstrated in operating systems for well over 500 hours, but has not yet been commercially deployed in California. The site for the demonstration was a closed landfill producing low quality gas that was flared. This site was a good match for the 250 kW demonstration as it eliminated the need for flaring of the otherwise unusable gas while generating electricity. However, due to issues with the major subcontractor and technology provider Ener-Core, the project scope was not completed by the end of the agreement term.

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

If the project was successful, it would have demonstrated and deployed a novel gradual oxidation system in conjunction with a gas turbine that is capable of converting low-grade, and otherwise unusable, landfill biogas into renewable electricity.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

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

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

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

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$145,560

EPIC Funds Encumbered:

$1,499,386

EPIC Funds Spent:

$1,020,425

Match Partner and Funding Split:

Ener-Core, Inc.: $384,856 (19.9 %)

ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.: $5,000 (0.3 %)

Advanced Power and Energy Program (APEP) - University of California, Irvine: $48,489 (2.5 %)

Match Funding:

$438,345

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 23 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Site engineering, drawings, and permitting requirements were completed in early 2016. An interconnection study with two supplemental reviews was completed by Southern California Edison in late 2016. The study identified the need for substation upgrades and an interconnection cost which far exceeded the budgeted amount. Consequently, the project sought a new landfill host site to demonstrate the novel gradual oxidation technology. A new site (with an existing interconnection agreement) was found and confirmed in mid-2017. However, the equipment installation continued to be delayed due to issues with a major subcontractor and the equipment developer, Ener-Core. In December 2018, CEC staff learned that due to funding issues, Ener-Core was not able to move forward with the project. A stop work order was issued in December 2018 and the project term ended with an unfulfilled scope.

Project Name: EPC-14-033 - North Fork Community Power Forest Bioenergy Facility Demonstration

Recipient/Contractor: The Watershed Research and Training Center

Investment Plan: 2012-2014 Triennial Investment Plan, 2015-2017 Triennial Investment Plan

Project Term: 5/15/2015 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Emerging Clean Energy Generation Technologies and Deployment Strategies, S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

Forest biomass fueled bioenergy gasification projects have the potential to be more efficient and have cleaner electricity generation than direct combustion systems, and can reduce the risk of forest fires and pollutant emissions. The electricity generation is anticipated to be economical in the long-term, but is dependent on the ability of developers to achieve necessary operating hours. Due to lack of sufficient data and the absence of commercially operating forest gasification facilities, there is a need to conduct demonstrations and collect technical data that will help advance the economic viability of this technology and attract private investment.

Project Description:

The goal of the North Fork Forest Bioenergy project is to demonstrate a 1 megawatt (MW) forest waste bioenergy gasification-to-electricity facility. The biomass gasification facility is targeted to be a commercial-scale, community-based facility capable of accepting and processing wood waste from forest management that would otherwise create wildfire and air quality challenges, and generating renewable grid-connected electricity. Once the gasification is fully installed and operational, the project team will investigate critical performance parameters and evaluate individual components and protocols to improve performance and reduce operating costs.

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

This commercial-ready gasification technology has not been previously demonstrated in California. Combined with the producer gas cleanup system, automation and control, and optimized operation, this innovative system will prove distributed, woody biomass-fueled electricity to be economically feasible and capable of operating for 7,000 hours a year. The project will be grid-connected and will provide immediate benefits, including

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

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

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

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

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

Consumer Appeal: Providing jobs, protecting homes, and enhancing the functioning forest ecosystems, increased biodiversity, and decreased wildfire threat are all benefits that this power plant will be able to promote to increase consumer appeal.

Energy Security: This project will rely on California-grown fuel and operates as a baseload plant. Development will also require PG&E and plant owners to invest in the local substation. The availability of local bioenergy power plant that is connected to and supplying power to the grid will increase energy security for the rural community.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$87,680

EPIC Funds Encumbered:

$4,965,420

EPIC Funds Spent:

$3,225,772

Match Partner and Funding Split:

The Watershed Research and Training Center: $22,706 (0.4 %)

Phoenix Energy: $684,144 (10.8 %)

Yosemite Sequoia Resource Conservation and Development Council: $55,500 (0.9 %)

Western Energy Systems: $253,750 (4.0 %)

North Fork Community Development Council: $180,000 (2.8 %)

USDA Forest Service - Sierra National Forest: $150,000 (2.4 %)

TSS Consultants: $13,260 (0.2 %)

Kamalesh Doshi: $2,000 (0.0 %)

Match Funding:

$1,361,360

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 23 bidders

Rank of Selected Applicant/ Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

On Dec. 31, 2019, the project received Green Bond financing for a total of $10,430,000 in tax-exempt bonds and $4,690,000 in taxable bonds, this is in addition to the earlier CalFIRE loan of $1.2M and equity investment of 2.2M from EQTEC. Financing was the only remaining unfulfilled requirement to release the Stop Work and so on January 6, 2020, CEC sent a letter to the recipient that releases the Stop Work Order. The Stop Work Order was put in place in September 2017 because of delays in equipment delivery and site construction due to lack of financing. The PPA with PG&E was approved in November 2017. Equipment from GE was delivered but was never installed, and as of August 2019, GE abandoned its gasifier and will not move forward. Phoenix Energy have since been working with another gasifier company EQTEC which provided equity investment as noted above.

Project Name: EPC-14-035 - Demonstration Of Integrated Photovoltaic Systems and Smart Inverter Functionality Utilizing Advanced Distribution Sensors

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

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

Project Description:

The project team developed, demonstrated, and evaluated at the LBNL Facility for Low Energy Experiments (FLEXLAB) test bed the ability of a smart inverter controller to enhance and optimize grid support and system performance of an integrated pilot scale of an advanced PV and storage system. The system includes a 14 kilowatt (kW) PV system and 19 kWh of battery storage. The project team evaluated the use of distribution synchrophasor unit data to support specific visualization and control applications on distribution circuits.

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

The project advanced the state of technology by introducing a smart inverter with an embedded synchrophasor that is scalable across investor-owned utility territory, enabling well-coordinated and managed high-density PV installations. The technology is particularly interesting to PV inverter manufacturers and system integrators of combined PV and battery storage systems. The information delivered by this technology informs inverter settings, in accordance with California Rule 21, with the overall objective to improve the reliability of the electrical grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: The installation includes 14 kW of PV and a 19 kWh battery providing 4.8 kW peak power for 4 hours. During the field testing, the controller responded and provided near optimal control of the storage system for a time-varying electricity price. The annual simulation indicated cost savings of up to 35 percent, with a payback time of about 6 years -- significantly shorter than the manufacturer's warranty of 10 years.

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

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

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$375,000

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$1,000,000

Match Partner and Funding Split:

Tesla, Inc: $25,000 (2.4 %)

Match Funding:

$25,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

The project team built a central infrastructure and models for power systems study, mitigation strategies and control schemes. This project is pushing the state of the art by developing a new controller architecture based on model predictive control (MPC) methods to provide optimal control of the entire system of battery storage, PV, and the building load, subject to a variety of power constraints, with the objective of minimizing the total energy cost for the customer. The results of this project are multifold and well aligned with the overall objective of enabling large renewable generation on the electrical power grid. The controller was field tested and improved over the course of 3 months. The team published the developed tools and models on four public repositories on GitHub; and presented project findings, and results at two technical conferences.

Project Name: EPC-14-036 - Smart Inverter Interoperability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage

Recipient/Contractor: SunSpec Alliance

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

High PV penetration with legacy inverters on California grid feeder circuits can exacerbate problems associated with grid stability. While inverter power technology exists to address grid operating variability, a standard and cost-effective communication interface to monitor and control inverter operating functions has not been broadly deployed. It is currently both expensive and risky for grid operators to monitor and control diverse distributed energy resource (DER) assets. There is a need for a test framework for smart inverter interoperability, empirical data to validate the effects of smart inverters on the grid, and market data to evaluate economic impacts.

Project Description:

The project developed a smart solar PV-based DER system showing a pathway for distributed energy resources to achieve critical mass and enable solutions for California's grid. The work included the development of a CA Rule 21 test framework and test scripts; compliance testing of smart inverters with functionality as described in the CPUC CA Rule 21 Smart Inverter Working Group (SIWG) recommendations; monitor and control inverter operating functions, including participation in ancillary service for diverse DER assets. The project delivered a smart inverter test framework and open-source software tools to enable rapid product development and safety testing and demonstrated the benefits to all stakeholders including ratepayers, utilities, manufacturers, investors and operators.

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

The project team developed smart inverter testing scripts for CA Rule 21 Phase 1 compliance. Testing proved that smart inverters made by different manufacturers perform CA Rule 21 Phase 1 autonomous functions in a manner consistent with the UL 1741 SA standard, thus increasing interoperability across PV system configurations and expanding customer choice. Project results showed that smart inverters compliant with CA Rule 21 Phase 1 requirements can be installed safely. Knowledge gained from the

project informed the development of the Common Smart Inverter Profile that forms the basis of CA Rule 21 Phase 2 compliance.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: A standard communication interface created by this project reduces labor installation costs, with savings of $0.05 per installed watt. Plug and play capability means that the sensor components and software interfaces can be preserved. Savings in IOU cost avoidance for circuit upgrades is estimated at $0.16 to $0.30 per installed watt.

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

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

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$162,005

EPIC Funds Encumbered:

$2,000,000

EPIC Funds Spent:

$1,992,095

Match Partner and Funding Split:

SunSpec Alliance: $1,421,875 (35.0 %)

Kitu Systems: $645,000 (15.9 %)

Match Funding:

$2,066,875

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 3; Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project developed, demonstrated, and evaluated CA Rule 21 Phase 1 and Phase 2 new smart-inverter standards that enable high photovoltaic penetration at penetration levels of 100 percent or more while simultaneously eliminating reverse energy flow and mitigating thermal problems associated with non-smart inverters. Financial analysis of using smart inverters showed annual saving of $640 million to $1.4 billion. The knowledge gained from the project is available to inverter and DER manufacturers, aggregators, end users, utilities, regulatory agencies, and other members of the public via SunSpec Alliance distribution channels including its website, newsletters, educational events, media outreach, and promotional events with the goal of promoting how open communication standards can positively impact the grid.

Project Name: EPC-14-038 - Fieldwork to Document Technology Adoption and Behavior Change Across Diverse Geographies and Populations to Inform Energy Efficiency Program Design

Recipient/Contractor: Indicia Consulting

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/8/2015 to 1/31/2019

Program Area and Strategic Objective:

Market Facilitation

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

Issue:

Technological innovation has been an impressive driver of efficiency gains; however, over time it has become clear that without a greater understanding of the human factors, potential energy savings will remain untapped. The goal of this research is to be able to recommend an alternative energy efficiency potential model. This new model would draw upon variables that are descriptive of culture and behavior among California sub-populations, and demonstrate the cost-effectiveness of programs designed to holistically address how different people experience and respond to technologies.

Project Description:

This project uses empirical research methods grounded in anthropology and other social and behavioral sciences to explore the factors affecting behavior beyond simple economic rationale. This practice is achieved by documenting and analyzing emerging attitudes, emotions, experience, habits, and practices around technology adoption for purposes of devising predictive indicators for on-going potential studies regarding energy consumption in California.

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

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

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: Understanding social, cultural and behavioral aspects of energy use and technology adoption can help utilities more cost-effectively and efficiently market their energy efficiency programs to hard-to-reach customer groups, resulting in greater participation and lower program implementation costs per kilowatt-hour saved.

Greater Reliability: New metrics on the impacts of utility energy efficiency programs for various subpopulations can increase the accuracy of energy demand forecasts used in Long Term Procurement Planning and Resource Adequacy proceedings.

Consumer Appeal: Energy efficiency programs that incorporate social, behavioral and cultural aspects into the program design are likely to have greater appeal to potential customers. The research includes recommendations on utility program design elements that are likely to appeal to the subset of customers who are more deeply engaged with their technological devices and who are more likely to use technology to manage and reduce their energy consumption.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$40,208

EPIC Funds Encumbered:

$574,545

EPIC Funds Spent:

$573,944

Match Partner and Funding Split:

Indicia Consulting: $52,500 (8.4 %)

California State University San Marcos

Match Funding:

$52,500

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

12 out of 12 bidders

Rank of Selected Applicant/ Bidder:

Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project investigated the engagement of households with personal consumer electronics (e.g. smartphones, tablets, laptops) in two utility territories in California. Through extensive analysis of interview data, the research team identified a psycho-social characteristic termed cybersensitivity. Cybersensitives are people who appear to exhibit a greater emotional connection to their phones, tablets, and other personal technology. The research team found that the sample groups segmented according to differentiated behaviors and attitudes related to engagement with devices and attitudes around electricity consumption and conservation. The research team recommend that utilities and other policy-makers, who are seeking larger energy savings, begin by targeting Cybersensitives for participation in feedback programs, using opt-in program design. The Final Report has been received.

Project Name: EPC-14-040 - Self-Tracking Concentrator Photovoltaics for Distributed Generation

Recipient/Contractor: Glint Photonics, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The highest efficiency PV cells are multijunction PV cells used in concentrator photovoltaic (CPV) systems, which offer about 40% conversion efficiency compared to about 16% for polycrystalline silicon. However, concentrator photovoltaic systems require special mounting and precision tracking, and the resulting cost and complexity has prevented them from achieving significant market penetration.

Project Description:

This research project developed, tested, and demonstrated a self-tracking concentrator photovoltaic (ST-CPV) system -- a new concentrator photovoltaic technology that does not require a precision mechanical tracker to keep it aligned to the sun. The ST-CPV panel contains a thin layer of fluids that passively respond to the changing solar angle, automatically adjusting optical pathways within the device to ensure that incident sunlight is captured and concentrated over a wide range of angles. The passive internal tracking allows ST-CPV panels to be mounted in a stationary configuration or with a simple single axis tracker. This makes the system highly economical, greatly reduces installation and maintenance complexity, and enables distributed generation with higher efficiency CPV modules.

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

The project team estimates that 50% of rooftops would be appropriate for ST-CPV systems in California, where the average direct solar resource is 78% or more of the total solar resource. The successful development of this technology will bring significant manufacturing employment opportunities to California. Unlike conventional PV modules, ST-CPV modules are well-suited to local manufacturing because they do not benefit significantly from colocation with the semiconductor foundry. CPV cell technology is an area where U.S. manufacturers have a substantial technical advantage over foreign competitors. An additional benefit conferred by this technology is an improved energy solution for remote off-grid communities.

Many of such communities are located in desert areas of California that are particularly well-suited to the use of ST-CPV panels as a result of the high direct solar resource.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) California Solar Initiative: R.12-11-005

Applicable Metrics: CPUC Metrics- 1a, 4a

Lower Costs: This research developed a novel self-tracking concentrator panel that does not require a precision mechanical tracker to maintain alignment of the sun. This technology can cut the installed system cost for distributed PV systems in half. This novel self-tracking concentrator panel has the potential of producing a LCOE below 3.5 ¢/kWh for high direct normal irradiance (DNI) locations.

Economic Development: The ST-CPV technology developed under this project will help boost rooftop-installed solar energy that will produce renewable electricity and contribute to the state's economy and job creation. Research indicates that the CPV market is interested in the coarse single-axis trackers, rather than on coarse two-axis trackers.

Environmental Benefits: Greater adoption of PV power will reduce greenhouse gas emissions. Specifically, commercial adoption of ST-CPV systems on rooftops will help offset several millions of metric tons of carbon dioxide equivalent (CO2e) compared to conventional generation.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$282,545

EPIC Funds Encumbered:

$999,940

EPIC Funds Spent:

$999,939

Match Partner and Funding Split:

United States Department of Energy: $1,000,000 (28.6 %)

U.S. Department of Energy: $1,500,000 (42.9 %)

Match Funding:

$2,500,000

Leverage Contributors:

United States Department of Energy: $200,000

Leveraged Funds:

$200,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

25 out of 27 bidders

Rank of Selected Applicant/ Bidder:

Group 4: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team built and tested the three generations of prototypes, and all met or exceeded their target performance. In extended outdoor testing, the final prototype provided consistent performance and demonstrated a peak electrical conversion efficiency of 22.5 percent, similar to the top performing silicon modules. The cost model for the CPV modules estimated a cell cost of $1/cm2 in large volume. The novel optical and mechanical architecture developed in this program also has useful application in the lighting field. Glint has spun off two new research projects from this work to provide novel adjustable high-efficiency lighting fixtures. Both of these projects offer substantial energy savings impact, and have strong commercial opportunities due to the design and functionality benefits they offer. Final Report is in review for publication.

Project Name: EPC-14-044 - Enabling Anaerobic Digestion Deployment for Municipal Solid Waste-to-Energy

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/30/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

Production of energy from waste biomass aligns with California's clean energy policies and diverts waste from landfills, reduces landfill methane and fossil carbon dioxide (CO2) emissions, reduces fossil fuel reliance, and improves grid reliability and resiliency. Using the organic fraction of California's municipal solid waste (MSW) for combined heat and power (CHP) generation would help the state meet its Renewables Portfolio Standard (RPS), diversify the mix of resources in the state's electric generation portfolio, and help municipal governments achieve sustainability goals.

Project Description:

The purpose of this project is to enable environmentally and economically sustainable deployment of technology that transforms organic municipal solid waste into heat, electricity, and compost via dry anaerobic digestion. A dry anaerobic digestion and composting facility processing the organic fraction of MSW has been scaled up from 40,000 tons/year to 90,000 tons/year to increase production of renewable electricity and heat.

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

This project provides valuable insight to identify optimum pathways that overcome barriers for large-scale deployment of biomass conversion technologies. The research has focused on overcoming barriers for urban stakeholders, including odor, access to the utility grid, and improved utilization of waste heat.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Combined heat and power: D.10-12-035., R.08-06-024. (closed)

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

Lower Costs: The renewable electricity and heat output has the potential to offset fossil fuel use, thus reducing fuel costs and helping to insulate ratepayers from future fluctuations in fossil fuel prices. This technology can produce up to 187.5 kWh electricity/tonne wet waste.

Economic Development: It is estimated that 10 percent diversion of California's organic MSW for CHP generation has the potential to produce about 0.5 terawatt-hours (TWh) of renewable electricity per year, as well as about 51 million therms of renewable heat energy per year. Zero Waste Energy Development Company (ZWEDC) will receive $178,482 to $464,486 under the biomass feed-in-tariff price in annual revenue from electricity sales.

Environmental Benefits: The strategies to minimize odor-causing and other air emissions will improve the potential for bioenergy facilities that can be sited in or near cities throughout California to reduce transportation costs. Avoided greenhouse gas emissions are estimated to be 298,651 metric tons CO2e per year.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$1,497,504

EPIC Funds Encumbered:

$4,300,000

EPIC Funds Spent:

$4,300,000

Match Partner and Funding Split:

Zero Waste Energy Development Company: $1,500,000 (25.9 %)

Match Funding:

$1,500,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 6

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team measured NOx emissions during several flaring events to establish primary NOx formation pathways, which may include thermal, fuel, and prompt NOx formation. The team performed air emission measurements and modeling to minimize odors and greenhouse gases from anaerobic digestion and the composting facility. The project team has also updated a Life Cycle Assessment model to identify opportunities for improved economic and environmental performance by quantifying the life-cycle cost, energy demand, and the greenhouse gas impacts of the existing ZWEDC facility and paths to scale-up. ZWEDC has interconnected to PG&E grid and enrolled in CAISO to enable sale of net electricity. This project was completed in March, 2019.

Project Name: EPC-14-045 - Advanced Recycling to 1-MW Municipal Solid Waste of Electricity Generation

Recipient/Contractor: Taylor Energy

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

In California, 30-million tons of organic materials are added to landfills each year. There is a broad gap in available technology and scientific knowledge required for economic use of municipal solid waste as a gasification feed, particularly in the 1-MWe to 20-MWe power output range. There is a market need to address refuse derived biomass as an opportunity feedstock and to address the equipment size range needed for distributed power generation in California communities.

Project Description:

This project designs, develops and tests a waste-to-energy Process Development Unit (PDU), involving conversion of Refuse Derived Biomass into clean fuel gas by thermal-catalytic gasification, reforming, and pulse detonation technology. This is a two-stage process, with a primary gasification stage, followed by a reforming stage; and hot filtration, followed by wet scrubbing of the process gas. This project tests a 3-pound per minute PDU, evaluates the results, and provides engineering data to design a 30 ton/day plant generating 1-MW electric power.

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

The project researches, develops, and verifies thermal catalytic gasification technology that will overcome technical and economic barriers preventing the use of refuse derived biomass (RDB) as an energy resource in California. Completion of the current gasification/reforming test program enables future scale-up to 30-ton/day RDB-to-energy (1-MWe scale), in preparation for commercial scale design at 300-ton/day, generating 10-MW of electricity with costs of less than $3,750/kWh of installed capacity.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Combined heat and power: D.10-12-035., R.08-06-024. (closed)

Applicable Metrics: CPUC Metrics- 2a, 4a, 4e

Lower Costs: The Levelized Cost of Electricity is estimated at $118/MWh for 10-MW scale, which results in ratepayer savings of approximately $30/MWh compared to grid supplier power that may average approximately $150/MWh through 2024.

Environmental Benefits: The project will divert MSW from landfills and generate electricity, reducing NOx emissions from flaring or direct combustion by approximately 6.5 TCO2e/year.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$168,742

EPIC Funds Encumbered:

$1,499,481

EPIC Funds Spent:

$1,499,480

Match Partner and Funding Split:

Taylor Energy: $46,616 (3.0 %)

Match Funding:

$46,616

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

25 out of 27 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Patent. Gasifying Carbon Materials: Jet Spouted bed Integrated with Draft-Tube Reformer, both powered by pulse-detonation -burner(s) and bed material optimum for the process.

Update:

Design, fabrication and installation of the major equipment, consisting of Process Development Unit, reformer, gas-flare and gas conditioning, at the host site was completed. Testing of the gasification system was completed. Initial startup of the gasification was performed using 8 lbs. of wood pellets, and then refuse derived biomass. The rate of char conversion was increased to 9.47% by operating pulse burner at 900 degrees C and a modification to the gasifier that allows char particles to stay longer in the gasification zone. This modification also resulted in increased syngas production. The Levelized Cost of Electricity was estimated at $118/MWh for 10-MW scale compared to grid supplier power that will likely average $150/MWh through 2024. This project was completed in March, 2019. The gasifier technology is now being refined and upgraded for future commercialization.

Project Name: EPC-14-046 - Lowering Food-Waste Co-digestion Costs through an Innovative Combination of a Pre-Sorting Technique and a Strategy for Cake Solids Reduction

Recipient/Contractor: Kennedy/Jenks Consultants, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

Energy generation potential through the digestion of municipal sewage at wastewater treatment plants (WWTP) and the co-digestion of fats, oils and grease (FOG) and food wastes is estimated at more than 600 megawatts (MW). While combined heat and power generation systems using digester gas are highly beneficial, several barriers exist that impede the installation of these systems. Among the key barriers for food waste co-digestion are the challenges in pre-processing food wastes prior to their addition to the digesters.

Project Description:

The project demonstrated two complementary approaches to lower the overall cost of co-digestion: a new technology to lower preprocessing cost of food wastes, and a new strategy to lower the mass of cake solids requiring disposal. The new technology for the preprocessing of food wastes uses an organic waste preprocessing technique known as an organic extrusion press (OEP) for selective extrusion of organic materials and is capable of recovering 95% of organics. The project applies a new strategy in operating co-digestion systems that involves optimizing the organic waste loading in a way that will lower the mass of cake solids requiring disposal relative to the conventional process.

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

This project developed a reliable and cost-effective bioenergy from wastewater treatment plants (WWTP) through the integration of an organic waste preprocessing technique known as organic extrusion press and co-digestion of locally available food waste and restaurant fats, oil, and grease (FOG) in an optimized manner that lowers the mass of cake solids that needs disposal. Though there is some seasonal variation, the supply of wastewater, food waste and FOG are very reliable.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

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

Greater Reliability: Applying the results of this project to waste water treatment facilities will reduce grid imports and provide a reliable generation source for these facilities and the grid. With the technology advancement supported by this project, the estimated increase in annual energy production at the demonstration facility is approximately 7,400 MWh.

Environmental Benefits: The technology from this project has the potential to reduce greenhouse gas emissions by 443,345 MTCO2e/year at a modest 10% market penetration. Furthermore, a lower volume of sludge requiring disposal will lower the emissions from trucks used for hauling sludge.

Public Health: The project will help avoid manual handling and separation of decomposable waste materials and divert up to around 4,100 tons per day of food wastes out of landfills. Manual separation of food waste risks staff exposure to unsanitary conditions and potential inhalation of pollutants from purifying organic materials, resulting in sickness and other adverse health effects.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$323,906

EPIC Funds Encumbered:

$1,496,902

EPIC Funds Spent:

$1,382,677

Match Partner and Funding Split:

Silicon Valley Clean Water (SVCW): $2,600,000 (63.0 %)

Water Environment & Reuse Foundation: $30,000 (0.7 %)

Match Funding:

$2,630,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 23 bidders

Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project successfully demonstrated two complementary approaches to lower the overall cost of co-digestion: a new technology to lower preprocessing cost of food wastes (FW), and a new strategy for the addition of Fats, Oil, Grease (FOG) or FW to lower the mass of cake solids requiring disposal. The technology uses an organic waste separation technique known as an organic extrusion press (OEP/OREX) for selective extrusion of organic materials that has a higher efficiency than conventional techniques. Also, the technology is more economical than typical source separation programs since it requires minimal preprocessing. Results indicated 54% savings compared to source separation and polishing of FW currently practiced. Economic evaluation of a 100 MGD plant indicated $8.9 to $9.3 million worth of energy savings by energy recovery, due to increased gas production.

Project Name: EPC-14-047 - Dairy Waste-to-Bioenergy via the Integration of Concentrating Solar Power and a High Temperature Conversion Process

Recipient/Contractor: Southern California Gas Company

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/15/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Because of the intermittent nature of many renewable energy sources, special attention must be taken when connecting them to the electrical grid. Energy storage technologies have the potential to increase the reliability of California's energy supply, as well as the ability to dispatch renewable energy sources on demand instead of upon production. Yet, traditional forms of energy storage are often prohibitively costly and lack mechanisms for participation in electricity markets.

Project Description:

The goal of the project is to integrate Concentrating Solar Power (CSP) and Hydrothermal Processing (HTP) into a single, integrated system; confirm that it can convert dairy manure into renewable natural gas (RNG) and bio-crude; study the economics of integrated CSP-HTP systems sited at dairy farms; and confirm that the RNG produced meets pipeline-transmission and geological-storage quality standards. The project seeks to prove that it is possible to store the energy contained in dairy manure waste in a manner that enables California natural gas plants to produce readily dispatchable, ultra-low-emissions renewable electricity.

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

This project will develop and demonstrate a new bioenergy pathway which utilizes hydrothermal processing and concentrating solar power to convert dairy manure into bio-crude and renewable natural gas that will enable dispatchable and low emissions renewable electricity.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Energy storage: R.15-03-011 (closed) SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1i, 2a, 3g, 4a, 4b, 4e

Lower Costs: Cost-effective production of pipeline-quality renewable natural gas and bio-crude will offset use of fossil fuels and provide a pathway for low-cost energy storage, reducing peak electricity costs, and lowering costs for ratepayers. The project team estimates a renewable electricity production cost of approximately $69 per MWh ($0.069 per kWh) -- cheaper than comparable renewable resources.

Economic Development: Commercialization of this technology would positively impact several markets including: dairies, fuel refineries, natural gas pipeline operators, and electricity producers. In addition, the project itself employs approximately 9 individuals in San Diego and Imperial County.

Environmental Benefits: By converting dairy manure into renewable natural gas and bio-crude, greenhouse gas emissions typically associated with manure can be avoided. The project teams estimates that a commercial-scale facility using this technology would result in annual net greenhouse gas emission reductions of approximately 3,440 metric tons of carbon dioxide equivalent per year.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$96,773

EPIC Funds Encumbered:

$1,494,736

EPIC Funds Spent:

$1,490,418

Match Partner and Funding Split:

Southern California Gas Company (SoCalGas): $600,000 (28.6 %)

Match Funding:

$600,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Redesign of the CSP receiver was completed by the National Renewable Energy Laboratory (NREL), resulting in fabrication of the receiver in 2017. Design and fabrication of the Genifuel hydrothermal processing (HTP) unit was completed with input from the Pacific Northwest National Laboratories (PNNL). Construction of the HTP system was completed and the Hyperlight CSP facility was expanded to a half acre in size using redesigned collectors and receivers. The HTP system was commissioned and testing was completed after integration with the Hyperlight system. This is the first project where CSP and HTP technologies have been integrated. This project was completed in March, 2019. Southern California Gas Company is planning to use HTP system in the future for other projects.

Project Name: EPC-14-050 - City of Fremont Fire Stations Microgrid Project

Recipient/Contractor: Gridscape Solutions

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/8/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

California needs to make better use of locally available renewable energy to increase resiliency and address climate change impacts, such as increased fires, severe storms, and heatwaves. Critical facilities are especially vulnerable to climate change impacts that disrupt the normal delivery of energy needed for their operation. Microgrids can help increase the resiliency of critical facilities such as fire stations through maximizing use of local renewable energy with energy storage.

Project Description:

The project team designed and built microgrids at three fire stations in Fremont, California. Each microgrid consists of a microgrid energy management system, a parking lot canopy photovoltaic system, and a battery energy storage system. The automated microgrid control system manages local energy resources and loads. The microgrids are designed to provide at least three hours a day of power for critical loads during a utility power outage.

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

Critical facilities, such as fire stations, are vulnerable to power outages, so having local, renewable generation decreases their dependence on outside electricity sources. This is the first implementation of microgrids for several fire stations in the region and creates a great opportunity for proof of concept to overcome risk and knowledge barriers to adopting high penetration solar PV systems and energy storage, demonstrate energy efficiency by optimizing power generation and loads, and provide increased energy security during utility power outages. The microgrids help reduce grid congestion and increase grid reliability.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a

Greater Reliability: This project helps reduce grid congestion and improve resiliency for the distribution system by combining local photovoltaic generation and energy storage, thus reducing the utility load where substations are near maximum capacity. The fire stations are able to operate at least three hours a day during a utility outage.

Environmental Benefits: This project will reduce carbon dioxide emissions by using local clean power generation (solar photovoltaics) and energy storage when available. This emissions reduction will help the City of Fremont meet its greenhouse gas emission target and achieve its zero net energy goals for city government buildings.

Energy Security: The fire station microgrids provide at least three hours a day of electricity to critical loads during utility power outages. The fire stations are vulnerable to earthquakes from the nearby Hayward faults, so having local, renewable generation decreases their dependence on outside electricity sources.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$73,475

EPIC Funds Encumbered:

$1,817,925

EPIC Funds Spent:

$1,817,671

Match Partner and Funding Split:

Delta Products Corporation: $71,691 (2.9 %)

City of Fremont: $80,000 (3.2 %)

Microgrid Energy: $10,000 (0.4 %)

Gridscape Solutions, Inc.: $495,569 (20.0 %)

Match Funding:

$657,260

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 40 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Gridscape Solutions successfully completed the microgrid project in March 2019. Because of the widespread awareness of the public safety power shutoff, these microgrids at Fremont fire stations received a lot of interest, and were featured in several news articles and reports. Gridscape Solutions is expecting to have more than 25 microgrids designed and deployed by the end of 2020. The final report, *Solar Emergency Microgrids for Fremont Fire Stations - Demonstrating Energy Savings and Grid Resilience for Critical Facilities* has been published.

Project Name: EPC-14-051 - Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy

Recipient/Contractor: All Power Labs, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/15/2015 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

California has an opportunity to help achieve the state's renewable energy goals using biomass from forest management. Gasification is a key technology for forest biomass-to-energy conversion that can increase reliability, lower costs, cut greenhouse gas (GHG) emissions, and help reduce the risks from forest fires. Current related technologies are not profitable at distributed scales. Further, any negative environmental impacts from the use of forest waste and biomass resources in the state must be mitigated with appropriate technology and management strategy.

Project Description:

This project aims to design, deploy, and test a 150 kilowatt-electric (kWe) modular, mobile biomass gasification generator (the Powertainer) that converts forest slash biomass into on-demand renewable energy that meets the California Air Emission Standards. The results of the demonstration will inform the optimal siting of such systems to enhance grid stability and the impact of monetizing current forest waste as fuel on forest thinning, hydrological resources, and wildfire risk.

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

This project develops and demonstrates a high-capacity, mobile conversion system capable of cost-effectively converting forest biomass near where it is sourced into renewable, on-demand energy to help address a myriad of issues associated with climate change, including drought, fires, and the need for more renewable energy.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: The project uses increased forest thinning to produce renewable energy more economically via a low cost modular and mobile biomass gasification technology that is able to have a levelized cost of energy at or below SB1122 incentive target levels. It is estimated that the 150 kW Powertainer has a energy cost reduction of $97,761, assuming 788,400 kWh sold at $124/MWh.

Greater Reliability: The Powertainer has the potential to offer flexibility in meeting location-specific needs while supporting critical operations and mitigating fire events. For a 150 KW Powertainer unit running one full year at a 60% capacity factor, it is estimated a potential of annual electricity saving of 788,400 kWh and peak load reduction of 150 kW.

Environmental Benefits: The deployment of the Powertainer to address the tree mortality crisis would require 9,589 units of 150 kW and consume 10 million bone dry ton per year at a capacity factor of 60 percent. This scenario would produce 7,560-gigawatt hour of renewable energy. When compared to open pile burning, this technology would reduce carbon dioxide (CO2) emissions by 20.3 percent, methane by 51.7 percent, CO by 99.9 percent, and PM by 99.9 percent. The technology has the capacity to sequester 1.45 million metric tons per year of CO2, create 7,000 jobs, and manage 700,000 acres/year.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$311,727

EPIC Funds Encumbered:

$1,890,125

EPIC Funds Spent:

$1,881,963

Match Partner and Funding Split:

All Power Labs, Inc.: $686,038 (26.6 %)

Match Funding:

$686,038

Leverage Contributors:

National Science Foundation: $225,000

Leveraged Funds:

$225,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The 150-kW Powertainer (PT) demonstrated how a containerized and portable gasification system could address the tree mortality crisis by converting forestry waste into clean, renewable energy and sequestering carbon at locations that can best utilize available fuel. During the 40 hours of performance testing, the technology met the majority of the performance targets set in the testing plan; however, the PT was not able to reach the expected electrical output of 150 kW during this test period. The system achieved 100 kW at maximum power with stable power production at 50 kW. The PT progressed from a technology readiness level of 4 to 6. The next generation of the Powertainer is targeted to advance the TRL to a commercial readiness level.

Project Name: EPC-14-052 - Community Scale Digester with Advanced Interconnection to the Electrical Grid

Recipient/Contractor: Organic Energy Solutions, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/1/2015 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

Digester systems have the potential to play an important role in providing renewable electricity while reducing California's greenhouse gas emissions. Despite a regulatory environment encouraging renewable energy production and greenhouse gas reductions, there is a need for technology to lower the system cost as traditional methods require high capital costs to remove organic materials from the wastewater stream to create good quality slurry for an anaerobic digester system.

Project Description:

The project's aim is to install and operate an innovative anaerobic digestion system using a high-rate biodigester technology that will process approximately 50 tons per day (TPD) of organic waste from a large supermarket (Albertsons) distribution center and 50 TPD (20,000 gallons) of high-strength slurry created by recovering and concentrating organics in wastewater streams. This project is co-located with the Co-West Commodities Wastewater Pre-Treatment Facility - an operation that collects wastewater (carbs, sugar, protein, and fat, grease, and oil) from industrial businesses and pre-treats the material for disposal into the local sewer system.

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

The project will demonstrate the use of electrical generation powered by digester gas to provide reliable power to a critical facility during outages on the grid. The electricity from this project will be exported to the SoCal Edison distribution grid through a SB 1122 Bioenergy Feed-in Tariff. The system will also be equipped with islanding capability to support the critical facility during an interruption in the grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

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

Lower Costs: The method developed by this project would lower the system cost, resulting in a significantly lower price of electricity compared to traditional or fossil generation. The estimated LCOE is $122/MWh.

Greater Reliability: This project will provide reliable renewable electricity without the need for standby and backup power and capable of providing power during peak energy demand.

Economic Development: The co-products are 1,226 tons of residual solids for vermicomposting feedstock per year and 1.6M gallons per year of liquid effluent for fertilizer.

Environmental Benefits: The project will divert and use food wastes to generate electricity that will yield reductions in greenhouse gas emissions, with a net offset of 4,125 MT CO2e/year. It will also improve environmental quality by providing clean energy while improving wastewater quality and reducing odor via anaerobic digestion.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$252,977

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$4,303,553

Match Partner and Funding Split:

Organic Energy Solutions: $7,700,539 (60.3 %)

CleanWorld: $75,400 (0.6 %)

Match Funding:

$7,772,939

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project experienced delays in interconnection and permitting processes. As a result, the grantee was not be able to complete the installation and testing within the previously-extended agreement term. CEC granted a time extension through March, 2020 to be funded at the recipient's expense. Construction is underway and nearing completion. Project outcomes will be reported to the CEC in March, 2020.

Project Name: EPC-14-053 - A Renewable Based Direct Current Building Scale Microgrid

Recipient/Contractor: Robert Bosch LLC

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

Microgrids can enable a building owner to lower operating costs and to operate in a grid outage. Microgrids developed to date rely on converting direct current (DC) from renewable generation to alternating current (AC) to support building loads. However, DC to AC conversion results in energy losses. A potential solution to further increase the benefits of microgrids is to develop a DC-based building with DC loads (e.g., lighting, fans). DC buildings are a research area that has not been evaluated fully by extensive research, and require proof of concept to gain traction in the market.

Project Description:

The team developed a DC microgrid that connects on-site generation directly with loads and provides a low cost, energy-efficient solution for warehouse facilities. Solar PV is directly connected to energy-efficient DC lighting, a DC energy storage system, and ventilation to form a DC building microgrid.

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

This project demonstrated the feasibility and benefits of a commercial-scale DC building microgrid that uses multiple DC technologies to provide reliable power to the loads on DC circuits, resilience during grid outages, increased energy efficiency and renewable energy utilization with lower losses. Additionally, the project team was able to obtain Title 24 approval for their DC design and an interconnection agreement with the local utility. Both steps were first of a kind approvals for a facility such as the large automotive distribution facility used for the demonstration.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs: By operating advanced technologies such as LED lighting and energy storage systems on DC power as opposed to AC power, installation and operating costs will be reduced, improving the economics for microgrid deployment.. The project was able to demonstrate an overall energy efficiency improvement of the lighting, ventilation and fork-lift charging loads improved by approximately 3-5% due to DC operations, while the efficiency of the energy storage device improved by 8%.

Greater Reliability: Bosch has validated that this microgrid supports all the critical loads during a grid outage for smooth operations (e.g., warehouse lighting, ventilation, fork-lift charging), and eliminates the requirement to run the diesel generator.

Environmental Benefits: If adopted by 2-5 percent of commercial buildings in California, a DC microgrid can result in 128 gigawatt-hours per year of energy savings. This translates to avoided carbon dioxide emissions of 36,000 metric tons per year, and avoided NOx emissions of 343 metric tons per year.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$276,825

EPIC Funds Encumbered:

$2,817,566

EPIC Funds Spent:

$2,389,216

Match Partner and Funding Split:

Regents of the University of California, Davis - California Lighting Technology Center: $9,183 (0.2 %)

Maxwell Technologies: $56,393 (1.2 %)

Imergy Power Systems: $45,000 (1.0 %)

AMERICAN HONDA MOTOR COMPANY, INC.: $110,631 (2.4 %)

Robert Bosch LLC: $1,576,337 (34.2 %)

Match Funding:

$1,797,544

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 40 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is complete and the final report is in the publication process. The microgrid, operated by a Bosch microgrid controller system, reduced the need for inverters for PV and rectification equipment for the loads. The microgrid improved the overall utilization of solar energy by roughly 7-10% as compared to conventional AC systems, while lowering component complexity and costs.

Project Name: EPC-14-055 - Las Positas College Microgrid

Recipient/Contractor: Chabot-Las Positas Community College District

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/8/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

California needs to make better use of distributed renewable energy sources to increase resiliency. Microgrids can reliably integrate energy efficient demand-side assets, distributed clean energy generation, and smart grid components to enable energy smart facility operation which is critical for academic and commercial campuses. Microgrids can disconnect from the grid and provide islands of stable, independent power that maximizes the use of local renewable energy to provide areas of refuge to address climate change impacts such as increased fires, severe storms and heatwaves.

Project Description:

This project demonstrated the creation of an inexpensive microgrid to optimize distributed energy sources and uses for a campus by adding energy storage and advanced energy management tools and integrating them with legacy photovoltaics to form a community college microgrid.

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

The project identified and measured the benefits of microgrids for customers to shift peak energy use to coincide with peak solar production and reduce peak demands by demonstrating the capability of microgrids made from a mix of new and legacy equipment. This project measured the microgrid's benefits by using existing retail utility rates as well as simulating a demand response market.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs: Based on the campus' current tariff, the facility reduced their annual demand charges by approximately $60,000. In addition, $40,000 to $90,000 of cost savings can be achieved through thermal storage programming and demand response.

Greater Reliability: The project increased energy reliability on the campus by increasing the amount of solar energy that is used for campus operations instead of allowing uncontrolled export of solar energy to the local utility grid and reduced peak demands. Controlling the export of energy and peak demands on the grid increased reliability by reducing grid congestion.

Energy Security: The project increased energy security of the campus by enabling critical loads on the campus to island from the main distribution grid and operate for up to 10 hours with power generated from the campus solar PV system and stored in the new energy storage system.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$260,719

EPIC Funds Encumbered:

$1,522,591

EPIC Funds Spent:

$1,431,911

Match Partner and Funding Split:

Chabot-Las Positas Community College District: $450,000 (22.8 %)

Match Funding:

$450,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 40 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team completed the microgrid in March 2019. A final report titled "Making a Microgrid From Legacy Systems - Las Positas Microgrid" was posted and is available online.

Project Name: EPC-14-059 - Laguna Wastewater Treatment Plant Microgrid

Recipient/Contractor: Trane U.S., Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 8/27/2015 to 3/30/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

Critical facilities are vulnerable to climate change impacts, such as wildfires, that can disrupt the normal delivery of energy. Microgrid technologies are capable of improving a facility's energy resilience and providing additional value. This demonstration of a microgrid at a wastewater treatment plant developed a case study on the employing a microgrid at a wastewater treatment plant to provide sanitary services and control energy usage to participate in grid energy markets.

Project Description:

This project upgraded a wastewater treatment plant to use a microgrid with a solar photovoltaic system, energy storage, and a microgrid controller for increased resiliency and to participate in energy markets.

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

This project demonstrated that a microgrid at a wastewater treatment plant can operate without compromising water quality or negatively affecting plant operations. The EPIC funds demonstrated a functional microgrid by integrating energy storage, on-site generation, and control components and improved resilience.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5a, 5d

Lower Costs: This project used on site microgrid resources to reduce operating costs at the wastewater treatment facility by participating in the demand reduction energy market.

Public Health: This microgrid supports a critical facility that is vital to maintaining public health in an emergency.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$187,080

EPIC Funds Encumbered:

$4,999,804

EPIC Funds Spent:

$4,983,459

Match Partner and Funding Split:

City of Santa Rosa: $750,000 (10.3 %)

Nuvation Engineering: $1,200,000 (16.5 %)

Parker Hannifin Corp: $340,000 (4.7 %)

Match Funding:

$2,290,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 40 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project completed in March 2019 and the Final Report was published. The project successfully demonstrated a microgrid for a wastewater-treatment facility.

Project Name: EPC-14-061 - Learning from Real-World Experience to Understand Renewable Energy Impacts to Wildlife

Recipient/Contractor: U.S. Geological Survey

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 10/26/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

There is a general lack of data to adequately determine some impacts of renewable generation on wildlife and habitat loss. This lack of understanding presents challenges to assessing, mitigating, and permitting new renewable energy development.

Project Description:

This research used real-world data to understand renewable energy impacts to wildlife. The researchers analyzed data on wildlife fatalities and habitat loss to determine the significance of fatalities to population persistence; compared pre-construction predicted and post-construction actual impacts (fatalities) to sensitive species, as a foundation for improving predictive accuracy; and compared predicted and actual benefits of mitigation to sensitive species, as a foundation for improving predictive accuracy. The research goal was to gain a better understanding of the actual environmental impacts of renewable energy generation for wildlife. The information gathered through this process can then be used by land and wildlife managers and permitting and regulatory agencies to reduce those environmental impacts, thus lowering financial and environmental costs from energy generation.

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

This project developed and applied a unique combination of stable isotope analysis and demographic modeling to characterize wildlife populations of interest affected by fatalities at renewable energy facilities in California. The project also developed a novel application of techniques that evaluates statistical models to improve forecasting of wildlife fatality rates and mitigation outcomes. The approach was high-tech, scientifically-innovative, and ultimately subject to peer-review via publication in scientific journals. Implementation of this set of tools will benefit ratepayers by streamlining permitting and reducing costs of energy development and electricity.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 4f, 4g

Lower Costs: This project is expected to help streamline environmental permitting management (improving reliability and cost). Likewise, improved prediction of fatality and mitigation outcomes can ease and improve compliance with environmental requirements, which also reduces costs.

Greater Reliability: Having a better understanding of wildlife impacts and how to mitigate them could lead to more capacity via new renewable energy developments and higher capacity factors (e.g., reduced curtailments).

Environmental Benefits: Refining predictions associated with infrastructure development will reduce impacts to wildlife and improve mitigation effectiveness in future renewable energy development. The study prepared recommendations for future pre- and post-construction surveys so that they are more useful for wildlife regulators and permitting agencies.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$262,924

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$978,402

Match Partner and Funding Split:

US Geological Survey: $94,707 (3.6 %)

University of Maryland Center for Environmental Studies Appalachian Laboratory: $22,470 (0.9 %)

NextEra Energy: $1,500,000 (57.3 %)

Match Funding:

$1,617,177

Leverage Contributors:

Bureau of Land Management: $400,000

Leveraged Funds:

$400,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

12 out of 14 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project was completed in 2019, and the final report was received. Despite compiling more than 600 environmental reports, researchers concluded that it is largely impossible to assess the utility of pre-construction wildlife surveys to predict post-construction effects because of the lack of standardization. About 3,000 samples were prepared for isotopic analysis to determine the geographic origin of individuals. The research team developed populations models for 29 species to estimate the effect of fatalities at renewable energy facilities. Of the birds killed, those of predominantly local origin were especially likely to have lower population growth rates (they are declining) and greater adult survival (they are long-lived). The team shared sample material from carcasses with the team from EPC-15-043. The study published two journal articles, with several more underway.

Project Name: EPC-14-062 - Energy Efficiency in California's Water Sector Using Customized Energy Management and Supervisory Control and Data Acquisition Systems

Recipient/Contractor: The Regents of the University of California on behalf of the Riverside campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 7/1/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Many water and wastewater treatment facilities in California have a variety of older energy consuming equipment from different vendors each having their own unique communication protocols. Upgrades, modernization and integration of control equipment of various vintages present serious communication challenges for optimizing energy efficiency and peak demand management.

Project Description:

This project involves setting up links using software and hardware at pumping stations for water delivery, storage or treatment that enable the integration and transmission of data from energy meters directly or indirectly into Supervisory Control and Data Acquisition (SCADA) systems that are traditionally set up to monitor water quality parameters in real time. Combined with historical energy use data on the platform, operators can manage systems in real time to monitor and control peak demand.

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

This project highlighted a pathway for water and wastewater agencies in California to increase energy efficiency and reduce their peak energy consumption with no decrement in service or reliability by monitoring real time energy consumption. This project provided equipment energy data to the water district operators, who can make decisions on optimal equipment operation. The direct benefits to water districts were demand charge savings, O&M savings, and improved operational efficiency.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: The project reduced energy costs for water treatment facilities due to lower energy and demand costs. The EMS deployment resulted in a 41 percent peak demand reduction from one pumping site. This correlates to annual cost savings, based on demand charges, of $149,146 for one pumping site. The cost savings would be significant if EMS is deployed at all water and wastewater treatment facilities across California.

Environmental Benefits: Using the results in peak demand reductions for statewide adoption for emissions analysis, the resulting greenhouse gas emissions would decrease by 27 percent statewide from an annual generation of 448,950 MWh.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$452,544

EPIC Funds Encumbered:

$3,017,034

EPIC Funds Spent:

$2,274,513

Match Partner and Funding Split:

Opto 22: $94,198 (2.0 %)

OSISoft, LLC: $1,081,469 (22.8 %)

Regents of the University of California, Riverside Campus: $123,709 (2.6 %)

Cucamonga Valley Water District: $198,896 (4.2 %)

Inland Empire Utilities: $115,360 (2.4 %)

Olivehain Municipal Water District: $109,100 (2.3 %)

Match Funding:

$1,722,732

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant / Bidder:

Ranked # 6

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in March 2019. All water districts were able to successfully integrate the energy management system (EMS) into their existing SCADA system with the ability to integrate other pumping and treatment sites into the EMS. There were several benefits to the water districts including energy savings, reduction in demand charges, and operations and maintenance savings. All water district operators were able to monitor energy demand in real time to operate the system more efficiently. The EMS deployment at Cucamonga Valley Water District resulted in a 41 percent peak demand reduction from one pumping site. This correlates to annual cost savings, based on demand charges, of $149,146 for one pumping site. To share the results of the project, the Recipient hosted a workshop that brought together local officials, water system integrators and water districts.

Project Name: EPC-14-063 - Advance Wastewater Treatment Using Forward Osmosis to Produce High Quality Water

Recipient/Contractor: Porifera, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Industrial-scale wastewater treatment systems have the potential to save energy, reduce wastewater volumes, and generate pure water streams for on-site re-use. However, many industrial wastewaters are very difficult to treat, as they contain high levels of dissolved and suspended solids, making low cost treatment with membrane-based systems ineffectual.

Project Description:

This project demonstrates an advanced wastewater treatment technology, the PFO Recycler, that produces high quality water while reducing energy, chemicals and maintenance required for treatment of industrial wastewaters. The PFO Recycler uses forward osmosis to extract the water from the waste stream and reverse osmosis to extract the water out of the forward osmosis draw solution. If the project is successful then this technology could be used to treat challenging wastewaters to achieve high purity and provide high temperature water for reuse while using less energy than other processes. Reclaiming water for onsite reuse will reduce the need for fresh water purchases.

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

The project includes technological advancements in membrane development and module design in forward osmosis to address cost and performance issues. The demonstration projects are located at a winery, frozen food facility and a soap company. Each demonstration is documenting energy savings and potential for this technology to purify, concentrate and reuse challenging wastewaters that contains high levels of contaminants. This technology has the potential for application in the food and beverage, oil and gas, and other industrial sectors.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: This technology treats challenging industrial wastewaters for water reuse and resulted in energy and water saving benefits and cost savings. Results show between 20-40 percent energy savings compared to competing technologies while targeting 70-90 percent water recovery. This results in reduced operating costs. In the past all of the wastewater was disposed through the local wastewater treatment plant.

Environmental Benefits: By reducing electricity use and water use, the project reduced greenhouse gas emissions. With broad adoption, the technology has the potential to enable the reuse of industrial wastewaters rather than being disposed in the sewer system. The reuse of wastewater minimizes the need for fresh water.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$964,131

EPIC Funds Encumbered:

$3,230,420

EPIC Funds Spent:

$3,230,164

Match Partner and Funding Split:

Porifera, Inc.: $463,308 (12.0 %)

CDM Smith, Inc.: $9,885 (0.3 %)

Dr. Bronner's Magic Soaps: $59,000 (1.5 %)

Jackson Family Wines: $99,800 (2.6 %)

To Be Determined: $14,500 (0.4 %)

Match Funding:

$646,493

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant / Bidder:

Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Final report is under review for publication. Demonstration results show energy savings of at least 20% when targeting 70% water recovery and at least 40% energy savings when targeting 90% water recovery. The technology has been showcased at the California League of Food Processors Expo for several years and has gotten some interest from the industry to do more projects.

Project Name: EPC-14-065 - Demonstration of Forward Osmosis to Produce Juice Concentrate, Purify and Reuse Wastewater and Reduce Energy Use

Recipient/Contractor: Porifera, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

There is a need for energy efficient methods to concentrate food and beverage products and wastes under varying processing conditions and operations while preserving or improving product quality. Food and beverage industry operators are eager to implement new methods, but first need to be convinced of the effectiveness and efficiency of the technology without compromising the high quality standards of California's food and beverage products.

Project Description:

This project is demonstrating a new technology innovation, the PFO Concentrator, to reduce the energy, chemicals, and maintenance required for food and beverage processing and waste concentration. The PFO concentrator dewaters fruits and vegetables for production of food and beverage concentrates and purees and could replace energy intensive thermal evaporators. Additionally, water is extracted from the concentrated product for reuse on-site.

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

The technology uses forward osmosis and reverse osmosis in an energy efficient way to achieve the equipment performance of an evaporator and, in addition, generates purified water streams for reuse. This technology could lower energy use and costs for food processing and industrial operations through replacement of energy intensive thermal evaporators and reuse of wastewater streams onsite, rather than disposed through the municipal system.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The PFO concentrator demonstrated up to 80 percent of thermal and electrical energy savings compared to conventional technologies and water reuse of greater than 50 percent. This results in additional cost savings and negates the need to purchase potable water from local jurisdictions.

Environmental Benefits: Since this technology was proven to lower energy use and demonstrated the reduction in use of evaporators, it could lower greenhouse gas emissions through the reduction of natural gas required for operation. Also the project has demonstrated purification of wastewater for on-site reuse, thereby lessening need for fresh water purchases, while reducing water disposed through the sewer system.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$621,536

EPIC Funds Encumbered:

$2,499,289

EPIC Funds Spent:

$2,499,284

Match Partner and Funding Split:

CDM Smith, Inc.: $9,885 (0.3 %)

Porifera, Inc.: $233,108 (7.5 %)

Los Gatos Tomato: $385,575 (12.3 %)

Match Funding:

$628,568

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant / Bidder:

Ranked # 7

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project has been completed and the final report is under review for publication. The results show annual energy savings of up to 72 percent for wineries, 80 percent for industries with brine wastes, and 75 percent for tomato processing. There has been interest in continuing testing of other wine grape juice and even wine concentrate from Jackson Family Wines after the project.

Project Name: EPC-14-066 - High-Performance Integrated Window and Facade Solutions for California Buildings

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Building envelope systems directly affect electricity use for lighting and heating, ventilation and air conditioning (HVAC). These systems have a major impact on annual energy use, load shape, and peak demand. Better envelope system designs can play a significant role in helping to achieve state policy goals such as zero net energy (ZNE) buildings by 2030 and capturing aggressive savings in existing buildings beyond current best practice. However, many potentially high performance window and building envelope technologies and systems have struggled to gain significant market share due in part to cost and the complexity of providing market-ready business solutions.

Project Description:

This project develops, validates and quantifies energy impacts of a new generation of high performance building envelope systems such as highly insulating windows, novel window-integrated local ventilation, and dynamic daylight-redirection. It will provide design and management toolkits that will enable the building industry to meet challenging energy performance goals leading to zero net energy buildings. This project considers cost-effective integrated system approaches to reduce energy use associated with HVAC and lighting while improving occupant comfort.

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

This project further developed highly insulating windows (advanced TRL to 7), window-integrated ventilation systems (advanced TRL to 6), dynamic daylight redirecting systems (advanced TRL to 4), and dynamic, integrated window and facades through advanced controls (advanced TRL to 5). Technology enhancements include thermal improvements to glazing and frame, better management of air flow, ventilation and heat exchange in perimeter zones, doubling the depth of the perimeter zone that is effectively daylighted, and active load management controls in response to whole-building energy and grid needs. This project also improved modeling capabilities for advanced shading and daylighting systems which is a key interest to DOE moving forward. Project simulations

indicate these technologies could reduce HVAC energy use up to 39 percent, and lighting energy use up to 54 percent.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a

Lower Costs: These technologies are estimated to be capable of reducing statewide energy use by 6,118 gigawatt-hours, peak electricity demand by 2,250 megawatts, and statewide electricity costs by $867 million/year assuming 75 percent market penetration in new and existing commercial buildings.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,308,929

EPIC Funds Encumbered:

$3,000,000

EPIC Funds Spent:

$3,000,000

Match Partner and Funding Split:

United States Department of Energy: $450,000 (13.0 %)

Match Funding:

$450,000

Leverage Contributors:

United States Department of Energy: $450,000

Leveraged Funds:

$450,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 10

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-066 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project completed in March 2019. This project advanced knowledge and technologies in five areas: highly insulating windows; energy recovery-based facade ventilation systems (low-energy air flow through the facade); daylight redirecting systems (sunlight from windows reflected deep into the building); daylighting and shading optimization methods (daylight and solar heat gain models for simulating light-scattering shading and daylighting technologies); and integrated window and facades through advanced controls. Since these technologies are early prototypes, the team is continuing to pursue commercial development partners. The California Partnership for Advanced Windows was also formed to identify and overcome market barriers to facilitate market transformation toward highly insulating windows.

Project Name: EPC-14-067 - Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/29/2015 to 8/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Next-generation hydrographic data networks are needed to better measure and predict critical snowpack levels that can help hydropower operators adjust to increased variability and the impacts of climate change on precipitation.

Project Description:

The project will advance hydrologic modeling and improve the Precipitation-Runoff Modeling System (PRMS) used by PG&E, allowing for more effective management of hydropower resources. The project features an innovative smart wireless sensor network made up of small sensor stations mounted on poles linked by low-power radio, which produces real-time hydrologic data. These data, blended with satellite and Light Detection And Ranging (LiDAR) remote sensing data, have the potential to greatly improve hydrologic forecasting for the Sierra Nevada and other areas in California.

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

The project provides improved predictive planning and scheduling tools to manage hydroelectric resources that are needed to adapt to increasing vulnerabilities and uncertainties of a changing climate. This project specifically targets powerhouses operated by PG&E.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019 Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 2a, 3a, 5c

Lower Costs: The tools developed and enhanced by this project increase the ability of hydropower to respond to fluctuations in water supplies, helping lower the cost of energy production.

Greater Reliability: The quality of hydrologic data collected using installed remote sensing network and Snowpack Water Equivalent (SWE) maps derived from bi-weekly Light Detection and Ranging (LiDAR) scans show a marked improvement compared to the prominent Snow Data Assimilation System (SNODAS) results. The new methodology allows measurements of interception and radiation impacts to vegetation, and will be especially useful for hydrologic forecasts for areas affected by wildfires. The updated PRMSversion used by PG&E will reflect runoff changes due to the burn scars.

Environmental Benefits: Better, more-detailed, real-time predictions for water basin-runoffs will enable improved water management and adaptation to climate change.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$205,897

EPIC Funds Encumbered:

$1,100,000

EPIC Funds Spent:

$944,195

Match Partner and Funding Split:

University of California Merced: $86,263 (6.5 %)

California Department of Water Resources: $150,000 (11.2 %)

Match Funding:

$236,263

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

12 out of 14 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project was successfully completed in 2019. The research team installed hardware and collected hydrologic data for water years 2016, 2017, 2018 from four project sites: Grizzly Ridge, Kettle Rock, Buck's Lake, and Humbug. Data from in-situ snowpack measurements helped to improve Snowpack Water Equivalent (SWE) maps by 55%. The project team worked closely with hydrologists from PG&E and updated their working model of the Precipitation Runoff Modeling System (PRMS) from version 2 to version 4, which features updated topographical, climate, and vegetation data. Project results were published in the California 4th Climate Change Assessment Report. In addition, the project team published two peer-reviewed papers.

Project Name: EPC-14-070 - Wexus Energy and Water Management Mobile Software for the Agricultural Industry

Recipient/Contractor: GDRU Energy Solutions LLC (dba Wexus Technologies)

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California's agricultural industry is one of the state's largest users of energy and water and has been historically underserved by a lack of effective efficiency technologies. The agriculture industry is also rapidly transitioning to the next generation of technology: mobile, cloud-based software, big data, and connected devices in the field. The combination of rising energy rates, increasing regulation and reporting, drought and changing weather patterns is driving demand for new agricultural energy efficiency solutions. Farmers currently cannot manage what they do not measure, leading to higher operational costs for farms.

Project Description:

This project deploys the Wexus (Water-Energy Nexus) mobile, cloud-based software platform in California's agricultural industry. The Wexus platform leverages existing utility meter infrastructure and helps agribusinesses to quickly assess energy (and water) usage and cost from virtually anywhere on any mobile device. Through customized alerts and reporting, the platform allows farms to quickly respond to changes in energy usage, adjust and optimize equipment in the field, and reduce operational expenses due to energy costs. Through collaboration with project partners, this project will further extend existing water-energy data analysis, visualization and remote controlling capabilities to the Wexus platform to further optimize water-energy resource management in the agribusiness sector.

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

The Wexus software platform has leveraged existing AMI infrastructure and utility Green Button data platforms extensively to offer initial savings to partner farms without the need for additional hardware installations on site. The Wexus platform has also integrated this electricity data into tariff engines to compare rates and to estimate water usage for reporting.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: The project could reduce energy costs (and water costs where possible) for California farmers who may use Wexus Software solution to monitor their onsite electricity and water use. The estimated savings over three years for the four demonstration farms: 2.4 million kWh, 4000 acre feet of water, 600 metric tons of GHG emissions and more than $400,000.

Greater Reliability: Using the Wexus Software, California farms could reduce their demand and make informed decisions on the cost/benefit of participating in utility sponsored demand response programs while also contributing to grid flexibility.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$571,397

EPIC Funds Encumbered:

$4,000,000

EPIC Funds Spent:

$3,943,801

Match Partner and Funding Split:

Wexus Technologies, Incorporated: $1,000,000 (20.0 %)

Match Funding:

$1,000,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant / Bidder:

Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In terms of savings results, three of the four farms had substantially lower average electricity usage during the project period, thus achieving the targeted ten percent (10%) reduction from pre-project baseline values. In total, partner farms reduced electricity usage by 1.14 GWh/year or 17.2% on average unadjusted and by 38 MWh/year and one percent on average, when modeled as adjusted. The adjusted results are based upon several statistical models, which attempt to estimate the impact of factors outside the scope of the project (e.g. major farm operation/crop changes, weather, drought conditions, and EE equipment or renewable energy installations). The Wexus team looks forward to continuing to pioneer and refine this M&V/savings model for the agricultural industry and to implement it in new California third party energy efficiency programs.

Project Name: EPC-14-071 - Rotor-Mounted Bat Impact Deterrence System Design and Testing

Recipient/Contractor: Frontier Wind

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Some approaches to mitigating the impact of wind generation facilities on wildlife species, including bats, can limit the development and productivity of new wind energy projects. Developing advanced technologies and methods to mitigate fatal interaction of bat species with wind turbine facilities could enable wider deployment of wind energy with less curtailment.

Project Description:

The project designed and tested (in lab and field) a new system to discourage bats from colliding with wind turbines. The system uses ultrasound transmitters mounted in an array along the rotor blades, providing complete coverage over the entire rotor and nacelle envelope. A field test study using substantially similar methods to prior bat impact studies was implemented post-installation at the test site to measure the effectiveness of the new ultrasound system.

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

This project created an innovative bat impact deterrent system that may effectively prevent fatal bat interactions with wind turbines. The system has potential to yield a transformational impact on the field of bat impact mitigation. An effective, practical, cost-effective system design and test can enable commercialization and broad deployment of this technology. As a system that can be retrofitted into existing turbines and installed in new wind turbines, this technology could materially overcome a significant challenge of the wind power industry by reducing bat fatalities and injuries from turbine strikes while avoiding costly curtailments.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

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

Lower Costs: Currently available mitigation measures can be costly to ratepayers through forced curtailments and limit achievement of state renewable capacity expansion goals. As such, the system could benefit ratepayers by providing a less costly alternative approach.

Environmental Benefits: The project developed new technology that could significantly reduce bat fatalities at wind energy facilities in California and globally.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$31,238

EPIC Funds Encumbered:

$862,875

EPIC Funds Spent:

$713,707

Match Partner and Funding Split:

Frontier Wind: $22,313 (2.5 %)

Bruce Walker: $14,000 (1.6 %)

Match Funding:

$36,313

Leverage Contributors:

United States Department of Energy : $249,000

Leveraged Funds:

$249,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

12 out of 14 bidders

Rank of Selected Applicant/ Bidder:

Group 6: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-071 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project concluded in 2019, and the final report was received. Researchers completed the design stage for the system and tested it in their lab. The full system was installed on twelve turbines at Hatchet Ridge in 2016. Bat fatality surveys were conducted on the test turbines and control turbines during the fall 2016 bat migration season. Power supply problems disrupted the field testing, limiting the amount of useful data. Problems with the power supplies were diagnosed and resolved in 2018, but smoke from the Carr Fire prevented installation in time for the 2018 bat migration season. Therefore the team was unable to complete bat fatality surveys in 2019 to collect sufficient data to give a statistically robust estimate of the effectiveness of the system to reduce fatalities.

Project Name: EPC-14-075 - Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/15/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Historically, industrial facilities have paid little attention to electricity consumption. Many industrial customers are unaware of low-cost energy conservation and energy efficiency opportunities. Often the only electricity data available is at the whole facility level and cannot be easily analyzed to find energy-saving opportunities. Process-level sub-metering has been rare due to its historically high costs and it is typically not used to find ways to lower energy costs. Energy management systems that use real-time data and analysis to identify energy savings are not available in the market.

Project Description:

The University of California at Berkeley, Massachusetts Institute of Technology, and the University of Chicago, have partnered with Lightapp Technologies to demonstrate a pre-commercial, software-based, optimized energy management system in industrial facilities. Together, they will demonstrate Lightapp's energy-monitoring system on compressed air systems in 100 California industrial plants served by the state's investor-owned utilities.

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

The Lightapp technology takes an innovative approach by relating electricity use and operating measurements to the production outputs of specific facility systems. This project monitored compressed air systems over time, looking at both the supply side (the compressor) and the demand side (production). The software tool then identifies anomalies and makes recommendations to lower the overall energy intensity of production and save energy and money. This project demonstrates the operational effectiveness and financial viability of deploying a more developed version of the technology in California industries and optimizes electricity consumption in compressed air systems, a common system in many industries.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: The project showed that using the Lightapp platform can lower energy use and costs and optimize industrial processes in a variety of manufacturing sectors. Market assessments and technology deployed have estimated savings of 15% to 17% in compressed air system energy use with paybacks of less than 3 years. Preliminary savings analysis shows the participating plants reduced electricity use by 6.3 million kWh/year, saving $812,000. The recipient continued to monitor all the sites and information on the savings from all 102 sites will be available in January 2020.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$451,253

EPIC Funds Encumbered:

$4,981,729

EPIC Funds Spent:

$4,816,314

Match Partner and Funding Split:

University of California, Berkeley: $1,530,590 (23.5 %)

Match Funding:

$1,530,590

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant / Bidder:

Ranked # 8

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is complete. The Lightapp energy management system collected and analyzed data from sensors installed in 102 industrial facilities. The energy management system provided real-time data to facility personnel and customized recommendations on how to reduce energy use and optimize equipment performance. Annualized energy cost savings are estimated to be $812,000 and greenhouse gas reductions estimated to be 1,500 tons for the facilities analyzed. The industrial customer demand for the software-based system was high, with 22 percent of all eligible sites ageing to join the project 41 percent of all project participants opting to subscribe to the service at the end of the project. The Lightapp brand was changed to Zira in September 2019. The Zira platform provides additional functionality to the Lightapp platform to further help manufacturers optimize and reduce energy use.

Project Name: EPC-14-076 - Raw Wastewater Filtration to Increase Organic Removal Efficiency and Achieve Significant Electrical Savings

Recipient/Contractor: Kennedy/Jenks Consultants, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

The secondary biological wastewater treatment process is usually the most energy intensive process of a wastewater treatment plant (WWTP). The most common secondary biological treatment method is called the "activated sludge process", and is accomplished by aerating wastewater. On average the activated sludge process accounts for 40 to 60 percent of total WWTP electricity consumption. The electricity used for aeration is proportional to the organic load entering the aerated activated sludge process. Achieving a higher degree of removal of the organic load before the aerated activated sludge process provides a breakthrough opportunity to reduce electricity consumption.

Project Description:

This project is extending the application of Cloth Depth Filters (CDF) to raw wastewater filtration at three wastewater treatment plants in California. The CDF concept replaces the current technology of primary clarification by offering the following advantages: (1) substantially higher removal of organic load resulting in significantly lower aeration electrical power demand, and (2) smaller footprint requirements both for primary and secondary treatment steps. CDF employs established principles of gravitational forces which results in minimal operational and maintenance complexities. The unique attribute which offers promise for CDF technology in raw wastewater is the vertical placement of the filter medium and flow direction of this filtration process. Unlike prevailing filtration systems, the vertical orientation of the filter medium permits heavy solids to settle within the tank.

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

This project uses cloth depth filtration (CDF) for raw wastewater filtration to reduce the organic load on the secondary wastewater treatment step, which is the most energy intensive step in the treatment process. This breakthrough treatment using CDF has never been tested nor implemented at wastewater treatment plants.

Project results from the 18-month pilot demonstration at Linda County showed that a full-scale primary filtration using CDF technology is a feasible replacement of primary clarification process in the treatment of wasterwater in California.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: The project could reduce the cost of wastewater plant operations within California by reducing wastewater treatment plant electricity consumption (CPUC Metrics 1f and 1h). Assuming 10 percent market implementation by the wastewater treatment sector, this could result in annual savings of 34 million kWh and $3.6 million in reduced operating costs.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,184,735

EPIC Funds Encumbered:

$3,476,085

EPIC Funds Spent:

$3,392,789

Match Partner and Funding Split:

Kennedy/Jenks Consultants: $38,400 (0.8 %)

Aqua-Aerobic Systems, Inc.: $631,000 (13.2 %)

Process Wastewater Technologies LLC: $552,300 (11.6 %)

Linda County Water District: $29,640 (0.6 %)

Water Environment Research Foundation: $25,000 (0.5 %)

Regents of University of California, Davis: $12,000 (0.3 %)

Match Funding:

$1,288,340

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant/ Bidder:

Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-076 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project results have shown that primary filtration consistently removed 75-85 percent of suspended solids and 40-63 percent of organics from screened raw wastewater. Based on the 18-month demonstration at Linda County, full-scale primary filtration is a feasible replacement of primary clarification. Primary filtration is expected to have estimated annual energy savings ranging from $22,000 to $35,000 per million gallons per (mgd) day of facility average capacity. The project has also shown wastewater capital costs can be reduced in the range of $640,000 to $1.1 million per mgd of facility average capacity. The capital cost savings come from the 60-70 percent reduction in primary treatment footprint and increased secondary treatment capacity.

The project team will continue to market this technology to interested water utilities.

Project Name: EPC-14-079 - Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable more Residential Solar Energy

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Transformers are a key limiting component for the installation of solar generation on California's distribution systems. Transformer constraints together with distributed solar may result in voltage issues or inhibit permitting of solar. Smart inverters can help mitigate these issues. However, it is not known whether multiple inverters can operate side-by-side in stable conditions when each one is performing smart-inverter functions. High PV penetration on a distribution feeder may contribute to local over-voltage, variability, and equipment stress on the customer side, limiting PV deployments and production.

Project Description:

The purpose of this project is to resolve the limiting conditions that occur on California distribution systems when many PV systems are installed behind a single residential distribution transformer by evaluating advanced inverter functionality with the specific goal of enabling higher penetration of photovoltaics on the grid. The project is identifying, implementing, and testing (both in lab and field) optimal methods by which smart inverters can mitigate the issues that otherwise would limit local high penetrations of residential PV. The process will identify how California Rule 21 functions can be used and configured so that multiple smart inverters work in harmony and will also identify how other naturally-occurring consumer devices, such as electric vehicle chargers and other smart loads, can serve to further enable high-levels of solar PV.

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

As the penetration of autonomous (Rule 21) inverters increases, their interactions will grow in importance. This project will help provide a clear understanding of inverter characteristics and of their potential interactions that may help preserve the stability and reliability of the grid, benefiting both consumers and operators. Consumers who invest in solar PV systems (and utilities that provide incentives or expect benefits from PV) wish to maximize the power they can realize from their system. Sharing excess PV generation

with local loads may increase the utilization of such systems without negatively impacting the distribution grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: The use of smart inverter functions, together with smart (PV-optimized) behavior of loads, can increase production (KWh) of residential systems by 15%. For an affected consumer on a constrained distribution circuit, this means more annual savings.

Greater Reliability: The multi-inverter interaction testing and evaluation of smart inverter functions and smart management of consumer loads under this projects can minimize stress on grid equipment and will further improve reliability.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$400,537

EPIC Funds Encumbered:

$1,705,478

EPIC Funds Spent:

$1,285,598

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $149,452 (5.8 %)

Underwriters Laboratories, Inc.: $78,174 (3.0 %)

Southern California Edison Advanced Technology Organization: $260,000 (10.0 %)

Intwine Connect: $107,758 (4.1 %)

ClipperCreek, INC.: $66,480 (2.6 %)

Sacramento Municipal Utility District: $156,000 (6.0 %)

Pentair: $50,000 (1.9 %)

Emerson Climate Technologies: $8,550 (0.3 %)

A. O. Smith Corporate Technology Center: $15,000 (0.6 %)

Match Funding:

$891,414

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 27 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is currently in the laboratory testing phase. Work on test procedures has revealed inconsistencies among Rule 21 specifications of the California utilities, leading to questions about the proper configuration of currently-installed inverters. New comprehensive test procedures have been developed by the project to investigate these issues and may also provide improved data for modeling advanced function inverters. Recent bankruptcy filing by PG&E slowed lab activities and the difficulties in locating field-test sites was mainly influenced by the absence of Rule 21-compliant inverters from manufacturers; the new compliance deadline is in January 2020 and this makes it difficult to identify a manufacturer within the current project term that has a compliant inverter for field-testing. The project team is in the process of modifying its field testing plans.

Project Name: EPC-14-082 - Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid

Recipient/Contractor: Sierra Institute for Community and Environment

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 7/10/2015 to 12/31/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

Communities in the colder high Sierra regions of California often experience peak electrical loads during the winter due to a reliance on electric resistance heating, heat pumps with poor performance, and fuel switching from oil and propane to electricity when fossil fuel prices spike. These regions are also prone to catastrophic wildfires due to overstocked forests that exacerbate drought conditions. Electric and thermal energy from forest biomass clearing operations offer a unique opportunity to reduce peak loads using local renewable resources.

Project Description:

This project is deploying a biomass-fired combined heat and power system to provide heat and power to Plumas County health facilities. Biomass from local forest clearing operations will be used by a new biomass boiler to supply heat to an Organic Rankine Cycle (ORC) power unit. Waste heat from the ORC will be used as a heat source for heat pumps, improving their performance for the winter heating season.

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

This project will link emerging technology with opportunities to advance renewable energy, distributed generation, and clean energy job creation. The first-of-its-kind project combines a biomass-fired boiler with an Organic Rankine Cycle electric generator that diverts waste heat to source heat pumps, supplying economical heat and power to a community-scale entity currently experiencing high energy costs. The project will help sustain a market for locally-sourced, sustainable forest biomass, providing jobs to the community and helping to reduce the risk of catastrophic wildfires that threaten transmission infrastructure and public safety.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005 Combined heat and power: D.10-12-035., R.08-06-024. (closed)

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

Lower Costs: By generating up to 35 kilowatts electricity and using 400 kilowatts (thermal) to supply heat pumps, the Plumas County Health and Human Services center will reduce its energy costs (electricity plus propane) by $50,000 per year.

Greater Reliability: Electricity reliability will be enhanced by decreasing consumption of grid electricity during winter peak periods.

Increase Safety: Safety will be improved by reducing both the risk and destructiveness of wildfires in forest communities by removing up to 815 tons of forest waste biomass per year.

Environmental Benefits: Burning biomass in a controlled setting rather than in the field will result in reductions of pollutant emissions (including CO2, NOx, VOC and CO).

Energy Security: Energy security is enhanced by deploying 35 kilowatts of distributed electricity with waste heat utilization that will reduce load on the local grid and decrease peak demand by as much as 205 kilowatts.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$262,813

EPIC Funds Encumbered:

$2,385,261

EPIC Funds Spent:

$2,254,391

Match Partner and Funding Split:

Plumas County: $400,000 (13.4 %)

Sierra Institute for Community and Environment: $193,316 (6.5 %)

Match Funding:

$593,316

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

16 out of 22 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Facility construction occurred in the first and second quarters of 2018, with all equipment installed and commissioning completed in June, 2018. A ribbon-cutting ceremony was held in April, 2018, which included participants from the Sierra Institute, Plumas County, US Forest Service, community advocates, project developers, and the Energy Commission. Over the summer and early fall of 2018, Sierra Institute secured a steady fuel supply and trained County technicians to operate the system. The system was operated over the heating season from the fall of 2018 through the spring of 2019.

Project Name: EPC-14-084 - ABEC #4 Renewable Combined Heat and Power Project

Recipient/Contractor: ABEC #4 LLC CE&S Dairy Biogas

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

California has had limited success in the dairy biogas industry due to permitting obstacles and complexities, high environmental compliance costs, lack of long-term economical power purchase agreements, high financing risk and costs, and little commercialization of the industry. Further, dairy farmers typically are not experienced in building and operating digesters and generation systems. Combined Heat and Power (CHP) has the potential to increase dairy farm energy efficiency and reduce peak demand and dairy operation electricity costs. Projects demonstrating how dairies can benefit from CHP are critical to the success of future dairy digester-to-electricity projects.

Project Description:

The project uses biogas derived from on-site dairy manure to generate low-carbon, renewable electricity and to achieve high overall efficiency by capturing waste heat from the power generation system and using it to drive an absorption chiller. The absorption chiller is designed to convert waste heat into chilling capacity, which will be used to chill milk produced by the dairy cows. New absorption chiller capacity directly offsets electricity consumption from existing electric chillers. Combining renewable generation with waste heat collection and cooling, the project increases energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand.

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

The project represents a significant advance in dairy energy management by combining renewable generation with waste heat collection and cooling to increase energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand. The project benefits include substantial reductions in greenhouse gas emissions, lower manure handling costs, and generation and distribution of technical and economic data on community scale power production.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

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

Environmental Benefits: The double-lined lagoon enhances groundwater protection by minimizing leaching of manure into groundwater. Climate Trust estimates the carbon offsets that would likely be generated over the project's 10 year crediting period at 206,060 tonnes CO2e gross based on CARB's Livestock Protocol. The environmental benefits of this project include reduction of 11,012 metric tons of carbon dioxide (CO2) equivalents, and holding exhaust emissions to under 6.4 ppm of nitrous oxides (NOx) and 57 ppm carbon monoxide (CO) which are both well under California Air Resources Board (CARB) limits of 11 ppm NOx and 210 ppm CO.

Consumer Appeal: The project will improve odor control, through hydrogen sulfide removal, which is important to the dairy employees and benefits the local community. Progress has been made in limiting hydrogen sulfide (H2S) emissions from a high of 5000 ppm to under 100 ppm while utilizing only the air injection system, and under 7 ppm with a final iron sponge scrubbing.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$3,000,000

EPIC Funds Spent:

$2,984,446

Match Partner and Funding Split:

ABEC #4 LLC CE&S Dairy Biogas: $4,983,619 (62.4 %)

Match Funding:

$4,983,619

Leverage Contributors:

California Department of Food and Agriculture: $1,000,000

Leveraged Funds:

$1,000,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

16 out of 22 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

- Bioenergy Storage and Management System and Method.
- Lagoon Digester with Flexible Volume Capability.
- California Bioenergy LLC Lagoon Digester Systems.

Update:

The project accepted a PG&E 20-year Power Purchase Agreement with full operation and has collected operational data for one year commencing in the first quarter of 2018. Electrical production from the digester exceeded expected production during 2018. Monthly gross electrical production was more than 680,000 kWh. The project was completed in March, 2019.

Project Name: EPC-14-085 - Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System

Recipient/Contractor: The Regents of the University of California, Davis

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2015 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

The intermittent nature of solar energy generation requires special attention when connecting to the grid to ensure balance between energy demand and production. Although energy storage has the potential to serve multiple valuable functions in a microgrid setting, it is currently an expensive resource in the early stages of technology development. Renewable-based microgrids require a control system to support reliability.

Project Description:

This project is demonstrating a combination of advanced PV generation, energy storage, and an energy management system to reduce average daily power and daily peak energy demand by more than 10%. The project includes a smart electrical energy storage system that integrates retired electric vehicle batteries. The generator and storage system are controlled by a commercial-grade microgrid controller. The demonstration site is located in the Robert Mondavi Institute at the UC Davis campus.

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

The combination of advanced PV and the energy management system will result in a significant reduction in annual grid electricity consumption - estimated at over 80% or a cost savings of roughly $29,000 per year with associated greenhouse gas reductions of about 250 tons per year. Furthermore, the success of this project will provide follow-on benefits to California's large wine industry by proving that winemaking can be an environmentally-friendly process.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Smart grid: R.08-12-009 (closed) Smart Inverter: D.14-12-035 (in R.11-09-011) Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003

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

Lower Costs: The project aims to reduce the high costs of energy storage by using second-life electric vehicle batteries and an advanced energy management system. The combination of advanced PV and energy management systems will result in significant reduction in annual grid electricity consumption - estimated at over 80%, with electricity cost savings of $29,000 per year.

Economic Development: Proving the concept of a high-penetration renewable microgrid at the Robert Mondavi Institute is expected to lead to adoption of similar concepts at a number of winemaking facilities and breweries across California.

Environmental Benefits: The project will reduce CO2 emission by as much as 253 tons per year. Furthermore, the success of this project will provide follow-on benefits to California's large wine industry by proving that winemaking can be an environmentally-friendly process.

Consumer Appeal: California's wine and brewery market represents a significant market. The Robert Mondavi institute is generally considered a leader in this area, and if this concept is demonstrated successfully at this site, it is expected to be adopted elsewhere.

Energy Security: This project will increase energy security on the UC Davis campus by enabling a microgrid with the potential to function during grid outages.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$124,883

EPIC Funds Encumbered:

$1,238,491

EPIC Funds Spent:

$1,226,606

Match Partner and Funding Split:

Solexel: $12,000 (0.6 %)

UC Davis: $167,262 (8.8 %)

OSISoft, LLC: $479,467 (25.3 %)

Match Funding:

$658,729

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

16 out of 22 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The energy system project was installed in December 2018 and commissioned in January 2019.The system has been operating and collecting data since the beginning of 2019 and enabled analysis of the reduction in facility's energy demand. Project's success in second-life batteries applied to energy storage led to a start-up company to commercialize the idea. UC Davis have already a collaboration with Case Western University to share data from the system to aid in developing battery models used to predict the lifetime of these batteries as well as the life-cycle emissions from electric vehicle batteries. Results indicate up to $2,000/mo.in bill savings and up to 3000kgCO2/mo. in additional savings are possible with further controller optimizations. The project hosted tour groups including local or domestic groups and international visitors from different countries.

Project Name: EPC-14-088 - Demonstration of Low-Cost Liquid Cooling Technology for Data Centers

Recipient/Contractor: Asetek USA, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/13/2015 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California is home to many data centers which consume a disproportionate amount of electricity in California. Approximately 40 percent of the electricity used in data centers is used for cooling. As traditional building efficiency improves, data centers continue to grow in size and power. Improving data center cooling efficiency represents one of the major energy efficiency measures for this sector.

Project Description:

This project is validating the performance, reliability, cost savings and payback of a data center efficiency technology that uses direct-to-chip liquid-cooling to cut data center cooling energy use. The technology is being demonstrated at two full scale data centers with the goal of minimal operational disruptions during installation. Energy consumption, load, reliability and server performance are being monitored. The results of the demonstrations, along with "lessons learned", will be made broadly available to the data center community and public-policy makers to stimulate adoption of this technology.

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

If successful, the project will validate the performance, reliability, cost savings and payback of a data center efficiency technology that could reduce cooling costs while being able to be installed as a retrofit. This could lead to overcoming barriers to adoption by minimizing operational disruptions and costs compared with conventional installations and retrofits.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: This technology could reduce electricity use and cost for cooling data centers. The lifecycle energy cost savings is projected to be approximately 30% compared to standard cooling technologies used for existing data centers.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,038,931

EPIC Funds Encumbered:

$3,552,678

EPIC Funds Spent:

$3,103,726

Match Partner and Funding Split:

Asetek USA, Inc.: $303,726 (6.0 %)

Lawrence Livermore National Laboratory: $1,216,012 (24.0 %)

Match Funding:

$1,519,738

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant / Bidder:

Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-14-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is complete. All data centers are different, and the actual energy saved will vary, based on location and data center design. Demonstration results showed that the technology, RackCDU, is most cost-effectively deployed as a pre-installed solution with the greatest savings in high utilization data centers running high performance computing and high-density data centers. While there is performance improvement and energy savings, retrofits are disruptive and not economically viable. The analysis on one of the data center sites showed 5 percent energy savings. Greater savings of up to 10 percent is possible if the chilled water system was not used for heat rejection or if the data center was designed with the RackCDU technology. Knowledge from this project has been distributed at conferences and to data center operators, industry partners, customers and others.

Project Name: EPC-15-003 - Demonstration of Community Scale Generation System at the Chemehuevi Community Center

Recipient/Contractor: The Regents of the University of California, on behalf of the Riverside Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 10/29/2015 to 3/30/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

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

Issue:

The Chemehuevi Indian Tribe is located in Havasu Lake, CA and connected to Southern California Edison's power grid through a single transmission line. Due to its remote location, the Chemehuevi community faced power reliability issues and was extremely vulnerable to power outages and downtime maintenance. Along with these issues, there was a continual increase in energy, power, and ramping demand by the tribe. To mitigate these issues, a microgrid solution was proposed as a way to increase grid resiliency and reliability, while reducing electricity costs.

Project Description:

The purpose of this project is to deploy and demonstrate a community microgrid to improve site power reliability and resiliency. The Chemehuevi Indian Tribe Community Center microgrid incorporates a 90 kW solar PV system, a 25 kW/125 kWh Primus Power flow-battery combined and integrated with an EnSync Inc. energy management system to reduce peak energy demand for the center by utilizing battery storage to shift building and community loads. The system will also provide uninterruptable power for the center and serve as an Emergency Response Center for the tribe during blackouts or loss of power.

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

The project will result in greater electricity reliability, lower electricity costs, reduced peak energy demand, and avoidance of failures and outages by integrating a scalable system in both size and quantity and demonstrating the commercial feasibility to deploy many megawatt-hours of dispatchable energy integrated in a photovoltaic-battery storage configuration.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed) Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1g, 1h, 2a, 3f, 4a, 5a

Lower Costs: The system is designed to lower the kW demand by more than 10 percent of the daily average energy demand during peak times. This will result in a reduction of costs associated with procuring additional energy during periods of peak demand. Researchers estimate over $670,744 in energy savings from the solar PV system, $74,463 from energy storage revenue streams, and $38,910 in preventing costs due to sustained interruptions over a 20-year period.

Greater Reliability: Greater electricity reliability is achieved by managing energy use and local generation supported by PV generation and battery storage in daily energy use profiles. This will help reduce failures and outages associated with demand response.

Environmental Benefits: Researchers estimate a carbon reduction of 1,038 tons over the life of the project.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$525,157

EPIC Funds Encumbered:

$2,588,906

EPIC Funds Spent:

$1,749,988

Match Partner and Funding Split:

The Regents of the University of California - Riverside: $77,451 (2.4 %)

OSISoft, LLC: $479,467 (14.5 %)

Primus Power: $21,780 (0.7 %)

Chemehuevi Indian Tribe: $91,000 (2.8 %)

Solexel: $12,000 (0.4 %)

SunPower Corporation, Systems: $25,000 (0.8 %)

Match Funding:

$706,698

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

16 out of 22 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team completed the deployment, testing, and successful commissioning of the microgrid system in late 2018. In the first week of April 2019, the system was connected to SCE grid and started operation. However, during the first three months of operation, the Primus Power flow battery experienced technical issues and performance limitations. At the same period, EnSync Inc. experienced financial problems and went out of business. With two key subcontractors unable to support the operational needs of the project, CEC held a CPR meeting and issued a SWO for the project in August 2019. The SWO was released in October 2019 after the recipient provided an equipment replacement plan to upgrade the microgrid system and complete the project as originally envisioned and within the current budget and project term.

Project Name: EPC-15-004 - Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 8/3/2015 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Cooling and heating buildings contribute to a large portion of the electricity bills for California ratepayers. Traditional heating, ventilating and air conditioning (HVAC) systems waste energy. Innovations in HVAC systems, such as variable refrigerant flow and advanced indirect evaporative cooling systems are well suited for California climates. However, the full potential of these innovations has not been realized.

Project Description:

This project is developing and demonstrating a Climate Appropriate Air Conditioning system for commercial buildings that optimizes occupant comfort and can reduce energy use and peak demand. The project will apply a combination of variable refrigerant flow (VRF) technology with indirect evaporative cooling (IEC) integrated and operationally optimized through the building control system. The project will also investigate alternative non- ozone depleting potential (ODP) or low global warming (GWP) refrigerants and HVAC system designs that could enable their usage in commercial buildings. This project will benefit small and medium commercial buildings, such as retail stores, offices buildings and food service and could be implemented in existing and new commercial buildings through direct replacement of rooftop packaged air conditioners. It is estimated that the HVAC systems for these sectors use 7,000 GWh and contributes 5 GW of peak demand.

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

The technology advancement is the intelligent HVAC controller that processes signals from building sensors and system feedback to maximize system efficiency while also synchronizing operation of the VRF and IEC to reduce energy use and peak energy demand, and maximize occupant comfort. The innovative control system utilizes cloud-based optimization using weather, grid conditions and occupancy (CO2) as inputs to optimally operate a VRF and the IEC system to reduce both energy and water use. The IEC will be set up as a dedicated outdoor air system and incorporate variable speed

blower and heat recovery ventilation. These subsystems will also be intelligently controlled by the building controller. This project will also evaluate and provide system designs that use alternative refrigerants that have zero ODP or low GWP.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: This project could reduce electricity use for HVAC systems beyond 33 percent. This could mean lower energy costs for commercial building owners or occupants that pay utility bills.

Environmental Benefits: This project could reduce electricity use in HVAC systems beyond 33 percent and identify and test alternative refrigerants (propane, CO2, ammonia, primary/secondary systems and blends like R-32) that could significantly reduce greenhouse gas emissions. All tests look very promising. CO2 system tested has slightly lower cooling COP with slightly higher than average cooling capacity and higher heating capacity and higher heating COP. Further improvement to the capacity and COP of the CO2 unit is possible with increases in COP upwards of 20% possible. Compared to R410A system has slightly lower cooling COP at slightly higher cooling capacity but much higher heating capacity and COP.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,088,673

EPIC Funds Encumbered:

$2,834,721

EPIC Funds Spent:

$1,724,956

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $440,509 (13.4 %)

Match Funding:

$440,509

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 9

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

All projects test sites in San Diego, Alisio Viejo and Davis are being monitored and the final report is being drafted. Initial test results show electric savings of about 33 percent. Minor issues being addressed with new Melrok controller. Bundgard propane chiller system being tested, and CO2 and ammonia chillers have completed testing.

Project Name: EPC-15-008 - Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 11/16/2015 to 6/28/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

California's electricity system is vulnerable to a variety of weather- and climate-related events, and stakeholders involved in electricity system management, operations, and planning must have timely access to relevant, peer-reviewed data in a form that can support resilient decision-making. As part of California's Fourth Climate Change Assessment, a suite of energy sector research projects developed new projections of climate and climate-related parameters and used them to illuminate vulnerabilities and resilience options. The Cal-Adapt 2.0 platform -- developed and launched under EPIC funds -- enables energy sector stakeholders to access climate information and projection scenarios.

Project Description:

This project developed an interactive web-based platform to provide electricity system stakeholders with actionable data pertaining to local climate risks. The project developed web-based visualization applications depicting climate-related risks of relevance to the electricity infrastructure. The project also provided for access to climate, sea-level rise, hydrological, and wildfire projections associated with California's Fourth Climate Change Assessment. Data access is key to enabling integration of projected climate into infrastructure planning and risk management. As articulated by electricity investor-owned utilities in the 2017 IEPR Adaptation Workshop, Cal-Adapt 2.0 is an instrumental tool for developing and implementing locally-appropriate adaptation options in the electricity sector.

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

The platform developed in part by funds from this project continues to provide interactive visualizations and tools for download of data that directly support electricity sector decision-making with regard to infrastructure planning and management. In September, 2019, CPUC's decision on Topics 1 and 2 of its adaptation rulemaking anchored acceptable data for use by investor-owned utilities in California's Climate Change

Assessment process. CPUC's decision points to Cal-Adapt as a key data source, as free access to the data recommended by California's most recent (fourth) climate change assessment is provided on Cal-Adapt. Use of Cal-Adapt 2.0 to build climate resilience contributes multiple benefits to California's electricity ratepayers by helping to stabilize the grid, improve service reliability, and reduce financial losses associated with power outages.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 5a, 5d

Greater Reliability: Integrated planning supported by this project helps prepare for service reliability in a changing climate. For example, as discussed at the 2017 IEPR Adaptation Workshop, SDG&E is using Cal-Adapt to support a review of transmission line design standards. In fall 2018, PG&E, via Technical Advisory Committee participation, noted that they used hourly sea level data provided on Cal-Adapt for siting of transmission towers in the San Francisco Bay.

Energy Security: Integrated planning supported by this project helps stabilize the grid and reduce system outages.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$74,324

EPIC Funds Encumbered:

$400,000

EPIC Funds Spent:

$398,891

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

12 out of 13 bidders

Rank of Selected Applicant/ Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In November 2019, CPUC issued Decision 19-10-054 (Phase 1 of Adaptation Rulemaking18-04-019), which defines climate adaptation for investor-owned energy utilities in the state and directs IOUs to Cal-Adapt as a source of acceptable data for making resilient investments. In summer of 2019, the project final report was developed and submitted for publication.

Project Name: EPC-15-009 - Workforce Instruction for Standards and Efficiency (WISE)

Recipient/Contractor: California Homebuilding Foundation (CHF)

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 11/30/2015 to 3/31/2020

Program Area and Strategic Objective:

Market Facilitation

S17: Strengthen the Clean Energy Workforce by Creating Tools and Resources that Connect the Clean Energy Industry to the Labor Market

Issue:

California's homebuilding market emerged from the recession to find that many skilled tradespeople have permanently left the residential construction market. Meanwhile, techniques for constructing high performance attics, walls, and roof assemblies that were once considered "advanced practices" employed by few builders are now code requirements for new residential construction. The lack of skilled labor, coupled with increased demand for high-performance insulation techniques, could disrupt the rate of adoption of these measures or lead to poor installation of them. This may result in lower than expected energy savings and construction defects that impose safety risks.

Project Description:

This project is providing education, outreach, and resources for California's new residential building industry on high performance attics (HPAs) and high performance walls (HPWs), two new requirements in the state's 2016 Building Energy Efficiency Standards. The project helps the new residential building industry to better understand new requirements and options for compliance, and provides them with technical support to enable the transition to the new requirements. Additionally, the project team provides on-the-job training to homebuilders, installing trades, subcontractors, and field crews, on the proper installation of insulation, and on changes to other building systems that will be necessary to meet the new requirements.

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

The California Energy Code now requires new homes to be constructed with HPAs/HPWs, to meet energy efficiency standards. This project helps overcome market barriers for HPAs/HPWs by providing the construction industry with access to on-the-job training and tools on the best available technologies, techniques, and practices for complying with the new requirements.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: As builders become more familiar with proper installation practices and products are more widely deployed, the costs for installing HPAs and HPWs will be reduced. Additionally, proper installation will lead to energy savings, further reducing costs for ratepayers.

Increase Safety: Training will improve safety by ensuring builders follow manufacturers' code-compliant installation guidelines to reduce the risk of construction and structural defects.

Public Health: Supplemental ventilation training will ensure indoor air quality is unaffected or improved by changes to construction practices.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,667,291

EPIC Funds Encumbered:

$4,431,918

EPIC Funds Spent:

$3,184,527

Match Partner and Funding Split:

APA - Engineered Wood Association: $473,710 (2.4 %)

BASF: $990,000 (4.9 %)

Bayer Material Science: $1,230,290 (6.1 %)

California Building Industry Association (CBIA): $58,110 (0.3 %)

Ensoltis Green Hybrid Roofing: $631,600 (3.1 %)

KB Home: $3,043,501 (15.1 %)

Owens Corning: $2,327,444 (11.6 %)

Panasonic Eco Solutions North America: $265,200 (1.3 %)

PCBC: $151,200 (0.8 %)

QC Manufacturing: $335,220 (1.7 %)

Shea Homes: $2,248,622 (11.2 %)

SIPA - Structural Insulated Panel Association: $303,000 (1.5 %)

SPFA - Spray Polyurethane Foam Alliance: $239,000 (1.2 %)

Taylor Morrison Homes of California, LLC: $1,929,494 (9.6 %)

Tru Team of California: $1,008,684 (5.0 %)

ConSol: $450,000 (2.2 %)

Match Funding:

$15,685,075

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

4 out of 4 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team provided training and technical support to the building industry on HPA/HPW practices, including impacts of the 2019 Title 24 requirements on code compliance. This included a two-day classroom and hands-on training at a Passive House (built for high energy efficiency), educating industry participants on compliance options and proper installation techniques. Training modules were developed for a new online certification through High Performance Insulation Professionals. Informational materials and success stories were also updated on the project website: www.wisewarehouse.org. Finally, a new HPA/HPW curriculum was developed for the Building Industry Technology Academy, a statewide high school program that incorporated it into their annual build challenge for Southern California. The team continued offering training and scale-up measurement and verification activities through 2019.

Project Name: EPC-15-010 - Expanding Energy-Related Career Pathways in the Electrical Industry: Increasing Workforce Development Opportunities in Disadvantaged Communities and Delivering Training on Automated Demand Response Communication Equipment to Inside Wireman Apprentice

Recipient/Contractor: Center for Sustainable Energy

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 12/8/2015 to 3/31/2020

Program Area and Strategic Objective:

Market Facilitation

S17: Strengthen the Clean Energy Workforce by Creating Tools and Resources that Connect the Clean Energy Industry to the Labor Market

Issue:

Automated demand response (AutoDR) equipment and communications standards have evolved significantly over the past decade. However, these advances and standards have not been adequately translated into training programs to help facilitate the widespread deployment of AutoDR communication equipment. Lack of an adequately trained workforce could limit the benefits provided by demand response to electric customers and the larger grid.

Project Description:

The project is recruiting workers from disadvantaged communities into apprenticeship programs at California Joint Apprentice Training Centers (JATCs), providing them with comprehensive classroom and on-the-job training on the installation and maintenance of AutoDR communications equipment. By addressing the acute skills gap by producing a workforce qualified to install and maintain cutting-edge AutoDR communications equipment, the project is enabling demand response to be deployed in the market at scale.

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

The California Energy Code was updated in 2013 to require lighting systems in large buildings to be capable of receiving and automatically responding to at least one standards-based messaging protocol which enables demand response. This project is helping ensure a workforce that is trained in the proper installation and maintenance of AutoDR communications equipment exists to meet California Energy Code requirements for commercial buildings.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed) Demand Response (DR): R.13-09-011

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

Lower Costs: Proper installation of AutoDR communications equipment will facilitate greater levels of demand response by reducing the transaction costs for participating customers.

Greater Reliability: Compared to manual response, properly installed AutoDR communications equipment increases customer response to utility or system operator messages about a demand response event.

Economic Development: Training on the proper installation and maintenance of AutoDR communications can provide increased employment opportunities for workers in disadvantaged communities.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$863,874

EPIC Funds Encumbered:

$4,476,189

EPIC Funds Spent:

$1,994,025

Match Partner and Funding Split:

California LMCC IBEW-NECA: $16,165,080 (78.3 %)

Match Funding:

$16,165,080

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

4 out of 4 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the JATCs continued providing their online and in-person courses, and CSE continued working with project partners in disadvantaged communities to recruit new apprentices. Through November 2019, a total of 360 students have completed the course either in-person or online, and enrollment continues to grow. CSE also developed a green business network toolkit, as well as outreach materials for local governments and municipalities to encourage participation in the investor-owned utility demand response incentive programs. Towards the end of the year, CSE began efforts to start winding down the agreement, and will submit the final report in early 2020. To learn more about this project, visit: http://energycenter.org/demand-response.

Project Name: EPC-15-012 - Improving Membrane Treatment Energy Efficiency through Monitoring the Removal of Colloidal Particle Foulants

Recipient/Contractor: Kennedy/Jenks Consultants, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 1/30/2016 to 3/29/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Membrane treatment processes are highly energy intensive due to the fouling of the membranes over time. The high energy demand of low pressure membranes is caused by the accumulation of colloidal particles in the feedwater inside the membrane pores which increases the transmembrane pressure. There are no techniques to measure the levels of colloidal particles directly in wastewater, and minimize their deposition in membrane pores. As a result, many utilities do not pretreat the entering wastewater prior to membrane treatment. This results in membrane fouling and high energy use.

Project Description:

The project demonstrated an online monitoring technology for wastewater treatment plants to directly measure colloidal particle concentrations in order to lower membrane fouling and reduce energy use and maintenance costs. Direct detection of colloidal particles will help determine the optimal pretreatment needed to minimize deposition of colloidal particles in membrane pores.

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

Nationwide there are over 100 microfiltration/ultrafiltration treatment plants and there are over 100 reverse osmosis facilities in California using membranes. Membrane treatment for wastewater treatment is very energy intensive due to fouling of membranes over time. This project could overcome the barriers to use of membrane treatment by demonstrating a technology that can detect colloidal particles in membrane feed water. This can facilitate an optimal pretreatment process for their removal and reduce membrane fouling and energy costs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: The project reduced the frequency of cleaning and membrane replacement, energy use, and wastewater treatment plant operating costs by reducing the build-up in membrane pores and removing colloidal particles in the feed water during the pre-treatment phase. Based on pilot demonstration at OCWD, coagulant addition pretreatment could save $680,000 per year for reduced microfiltration(MF) chemical cleanings, $279,000 per year in reduced electricity consumption, and $1.76 million a year due to reduced membrane replacement frequency. This yields a total of $2,718,000 in savings for energy and other operating and maintenance costs.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$429,784

EPIC Funds Encumbered:

$1,167,034

EPIC Funds Spent:

$831,246

Match Partner and Funding Split:

Orange County Water District: $60,000 (4.0 %)

West Basin Municipal Water District: $50,000 (3.3 %)

Evoqua Water Technologies: $126,000 (8.4 %)

Malvern: $100,000 (6.7 %)

Match Funding:

$336,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders

Rank of Selected Applicant / Bidder:

Ranked # 9

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project is complete. Results indicate that the fouling potential for the microfiltration (MF) membranes tested at Orange County Water District (OCWD) was mitigated through use of targeted chemical addition. Test results show that fouling is reduced by 60% compared to the no coagulant addition. Energy and economic evaluation at OCWD indicated that the approach can reduce energy consumption due to MF by 28% and can result in 2,940 MWh/year savings. OCWD staff has made internal presentation of the project findings to its management. Recipient has presented the project results at five conferences attended by water/wastewater treatment plant staff, regulators and vendors. This project will be published in *Water World*, either as a podcast or article.

Project Name: EPC-15-013 - Open Source Platform For Plug-in Electric Vehicle Smart Charging in California

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 2/1/2016 to 1/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Technologies and Strategies That Optimize the Benefits of Plug in Electric Vehicles to the Electricity System

Issue:

Plug-in electric vehicles (PEVs) represent a rapidly proliferating new vehicle technology and source of utility grid load. Currently only pilot concepts exist for actively managing PEV charge control for the benefit of California's grid and ratepayers. Meanwhile California's electrical grid is evolving to rely more on intermittent renewable power sources, with different "grid acceptance" issues than more traditional generation sources, driven by the state Renewable Portfolio Standard (RPS), creating a unique opportunity for PEV charging and the "greening of the grid" to go hand-in-hand.

Project Description:

The project developed a one-way charging concept for PEVs that maximized intermittent renewable generation and minimized impacts to the distribution grid. The project focused on controlling the charging of plug-in electric vehicles (PEVs) in residential and small commercial settings using a novel and flexible open-source, open-software architecture charge communication and control platform. This software-based platform was embedded in the context of overall utility and residential and business electrical and building automation systems, lending itself to potential broad implementation by commercial interests due to its flexible architecture and "agnostic" approach to communications standards. Control strategies and applications were guided by an assessment of user needs and grid operation and ratepayer benefits, and the potential for one-way PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid.

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

This project focuses on controlling the charging of plug-in electric vehicles PEVs at residential and small commercial settings using a novel and flexible open-source, open-architecture charge communication and control platform. This XBOS-V platform is embedded in the context of overall utility and residential and business electrical and building automation systems, lending itself to potential broad implementation by

commercial interests. This integrated project also focuses on the development of the open-source platform including assessment of user needs and grid operation and ratepayer benefits, grid security considerations, and the potential for PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid. The platform is flexible to adoption and inclusion of several communication protocols.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 (closed)

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

Lower Costs: This project is estimated to result in $15 million per year reduction in electricity costs for ratepayers in 2024 from increased PEV charging energy efficiency and lower electricity generation costs.

Greater Reliability: This project is expected to increase reliability of the electric distribution grid and reduce frequency of outages in residential areas. Coordinated charging of PEVs in distribution networks could reduce impacts from sudden surges in charging (e.g., PEV owners in large groups set the timing of the charge to coincide with reductions in TOU rates after the evening peak). By coordinating the charge more carefully across utility distribution level nodes, these grid impacts can be greatly minimized based on initial project findings. Managed charging also has the potential to mitigate 500 GWh and 2 TWh of renewable overgeneration curtailment in 2024 and 2030, respectively

Environmental Benefits: This project could reduce carbon dioxide emissions by 72,500 metric tons per year in 2024 from increased PEV charging efficiency and increased fraction of intermittent operationally GHG-free renewable electricity generation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$262,826

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$1,357,291

Match Partner and Funding Split:

BMW of North America: $90,000 (5.7 %)

Match Funding:

$90,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

25 out of 25 bidders

Rank of Selected Applicant / Bidder:

Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

This project was completed in 2019. This project developed and demonstrated electric vehicle charging and building load aggregation and management in response to 15-minute ahead grid condition signals. The research team demonstrated local load optimization to reduce site energy consumption while meeting driver mobility needs, building functionality, and building occupant comfort. Load management strategies such as the one demonstrated in this project can have the potential to save ratepayers $15M per year in 2024 in lowered utility costs (at 1 percent market penetration).

The research team has released the source code on GitHub for public consumption, which has been downloaded about 50 times. About 20 buildings are currently capable of integrating the developed charging communication and control platform. The research team cannot track the number deployments.

Project Name: EPC-15-015 - Grid Communication Interface for Smart Electric Vehicle Services Research and Development

Recipient/Contractor: Andromeda Power, LLC

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 2/1/2016 to 1/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Technologies and Strategies That Optimize the Benefits of Plug in Electric Vehicles to the Electricity System

Issue:

The increase of distributed energy resources, including intermittent renewables and storage in plug-in electric vehicles (PEVs), makes the coordination of supply and demand to maintain the reliability of the distribution network challenging. PEVs are rapidly expanding in California and this will proportionally increase the installation of bidirectional charging stations, creating additional demand and potential stress on the grid. In order to effectively implement vehicle-to-grid (V2G) services, the grid has to be capable of effective machine-to-machine and user-to-machine communication.

Project Description:

Andromeda Power developed an advanced smart grid communication interface that allows utilities to send dispatch signals to PEVs in real-time to optimize the bidirectional power flow of PEV battery packs depending on local power conditions such as congestion, power quality, voltage and frequency, while maintaining the driver's mobility needs. The grid communication interface operates with a virtual machine that is able to interface with PEVs of any standard. The real-time monitoring and control of the stations provided the California electric investor-owned utilities with a means of quick, automated demand response.

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

This project enables the harmonization of V2G services, removing the communication barrier between PEVs of different standards and the grid. The communication interface enables Smart Demand Side Management benefits to the ratepayer with the possibility of using PEVs as distributed energy storage and controllable load. Local PEVs can mitigate the renewable over-generation and intermittency by storing renewable energy and delivering it to the grid on demand, potentially saving $1,861 per year for each PEV. The additional smart charging incentive can accelerate PEV adoption to achieve the targeted 1.5 million ZEVs on the road by 2025 and 5 million by 2030. Using PEVs as an energy

storage resource can reduce energy demand and stress of the grid, making the load predictable and more manageable.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1g, 2a, 4a, 5b

Lower Costs: The annual energy shift capacity introduced by InCISIVE is about 11 MWh/year (= 30 kWh x 365) toward the end of On-Peak period and in the following Mid-Peak period when marginal electricity is produced by natural gas peaker plants.

Environmental Benefits: Each PEV (30 kWh storage) optimally used for energy storage that charges and discharges once per day is estimated to result in approximately 7 metric tons per year of GHG reductions through the offsetting of natural gas peaker plants. Additional GHG reduction can be achieved using PEV batteries to store excess renewable energy to flatten the electric grid duck curve.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$223,081

EPIC Funds Encumbered:

$681,693

EPIC Funds Spent:

$622,482

Match Partner and Funding Split:

Verdek: $125,000 (10.9 %)

Suncharge: $340,000 (29.7 %)

Match Funding:

$465,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

25 out of 25 bidders

Rank of Selected Applicant/ Bidder:

Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in 2019. The project team designed and prototyped two models of Level 2 chargers capable of demand response according to the V1G (managed charging) use cases defined by SCE and PG&E. The project team conducted fast charge and discharge simulation of the PEVs using OpenADR signals and collected performance data. The EVSEs (Level 2 and Level 3) were integrated in a microgrid with 110 kW solar panels to demonstrate the feasibility of the InCISIVE system in mitigating renewable energy overgeneration. Using low-priced renewable energy stored in PEVs instead of energy from natural gas peakers results in energy savings of 21.9 MWh and about a $3,700 savings per PEV per year for California ratepayers.

Project Name: EPC-15-018 - Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems

Recipient/Contractor: Eos Energy Storage, LLC

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 3/22/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Residential, and commercial and industrial (C&I) customer rates are increasing. Also, outages as a result of natural disasters or to prevent wildfire ignition are increasing. Currently available energy storage technologies for these markets are not economical because of their high cost and short life. Also, safety and energy density limitations have prevented wide-spread deployment of energy storage on a distributed basis or at the point of consumption. Additionally, with new requirements for residential solar, the market is expecting a corresponding increase in the desire for safe and effective residential storage.

Project Description:

This project is developing and testing behind-the-meter residential and C&I battery storage applications, on both a stand-alone basis and modeled with solar PV. This project is utilizing several kW-scale, AC-integrated Znyth battery technology storage systems. The residential and commercial systems will be located at the University of California, San Diego (UCSD) campus. The project team is developing, modeling, and will be testing experimental rate designs and evaluating the impact on customer load profiles; developing control algorithms and demonstrating aggregation of multiple storage units to create virtual power plants that maximize the value of behind-the-meter storage to the utilities; and modeling, simulating, and extrapolating the economic impacts of installed systems and quantifying the benefits to California utilities and ratepayers.

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

This project aims to validate the safety, reliability, and performance of a new aqueous, zinc-based battery technology to support customer adoption in behind-the-meter energy storage markets and applications. Behind-the-meter application of energy storage has been identified as a major commercial market for energy storage, which requires detailed field performance data to open up this market for new and emerging energy storage technologies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1c, 1i, 2a, 4a, 5b

Lower Costs: This project will help lower energy costs for residential and C&I customers by providing behind-the-meter energy storage options that may help offset peak use rates and lower demand charge costs.

Increase Safety: Eos is the only company offering a battery technology that is inherently safer than competing technologies. This technology is non-flammable and non-toxic. In addition to being backed by UL- and ISO-certified quality assurance and control, the manufacturing process involves no toxic or hazardous materials.

Environmental Benefits: Expanding the use of behind-the-meter storage in the residential and C&I markets will reduce overall loads in conjunction with increasing solar PV, which will reduce greenhouse gas emissions, NOx, and SO2 from existing fossil fuel generators.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$218,866

EPIC Funds Encumbered:

$1,894,866

EPIC Funds Spent:

$1,302,092

Match Partner and Funding Split:

Eos Energy Storage, LLC: $1,436,801 (43.1 %)

Match Funding:

$1,436,801

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

35 out of 38 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, Eos commissioned the C&I system and began data collection. It is expected that Eos will integrate the residential system components in 2020, followed by installation, commissioning, and testing at UCSD.

Project Name: EPC-15-019 - Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps

Recipient/Contractor: The Regents of the University of California on behalf of the Davis campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Ground-coupled heat pumps (GCHPs) have been proven to deliver heating and cooling at higher levels of efficiency than air-source air conditioners and heat pumps. However, their application in mild climates, like California, is limited by the high cost of conventional ground heat exchangers (GHE), a component of GCHP systems.

Project Description:

This project is researching shallow (20-30 feet deep) and large diameter (2-3 feet diameter) helical coil, ground heat exchanger designs for ground source heat pumps. The project team is developing models, validating them with field data from two home sites and an outdoor lab, identifying optimal designs, and developing modeling methods that can be adapted for use with code compliance tools. The project also produces design specifications that will support future Title 24 eligibility criteria. A design guide is being developed for industry as a training aid, and a position paper is being prepared for the Department of Water Resources' California Geothermal Heat Exchange Well Standards Stakeholder Advisory Group.

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

The project spurs the market for high efficiency GCHPs by evaluating and testing an innovative method to reduce the cost of GHE, whose cost has been a barrier to more GCHP installations. The current method of drilling GHE bores requires costly, specialized deep drilling rigs, that often must be transported from out of state. Instead, by using common, locally available drilling equipment for shallow bores, GHE bore drilling can be done at lower cost. In addition, this technology will be made ready for commercialization by developing modeling tools needed to properly design, size, and evaluate energy savings and to facilitate use with California Title 24 standards compliance tools.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: This project seeks to reduce the cost of GHEs for heat pumps. Affordable GCHPs may result in lower utility costs for heating and cooling, lower maintenance costs, and improved system reliability compared to forced air systems. Estimated annual energy savings is over 67 billion BTU, assuming 40,000 single family homes built annually and 10% of new homes equipped with GCHPs. Annual electric savings from cooling efficiency in new homes is roughly 1.2 million kWh. For a 2100 sq ft home and a 2 ton system, and comparing the incremental cost for a GCHP system with conventional HVAC system, the annual cost savings per home is $173, when amortized over 30 years with tax credits.

Environmental Benefits: Assuming a 10% market penetration on new homes, estimated greenhouse gas emissions would be reduced by 8 million pounds per year.

Consumer Appeal: Increased use of GCHPs would eliminate noisy and visually unappealing outdoor condensing units. Also, GCHPs could improve comfort for residents compared to forced air systems.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$338,049

EPIC Funds Encumbered:

$1,212,186

EPIC Funds Spent:

$663,535

Match Partner and Funding Split:

Frontier Energy, Inc.: $18,826 (1.5 %)

Match Funding:

$18,826

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 12

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient is on track to complete the tasks and deliverables. The CEC's Buildings Standards Office and Engineering Office in Siting, Transmission & Environmental Protections Division provided comments on the Ground Couple Heat Pump Simulation Model tool, which enabled the recipient to set simulation parameters. The team completed installation of instrumentation at the outdoor lab site, and they started lab testing in October 2019. The data from this site will be used to develop a model to study the optimization of the ground heat exchanger design. The team has completed the test plan to validate the model. The validated model will be used to develop relationships describing the performance of shallow-bore, helical ground heat exchangers for use in EnergyPlus.

Project Name: EPC-15-020 - Intelligent HVAC Controls for Low Income Households: A Low Cost Non-connected Device that Understands Consumer Preferences and Performs Adaptive Optimization

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 3/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

HVAC energy use in low-income households, in many cases is the largest component of energy use. However, the efficiency issues associated with HVAC units are largely unaddressed due to cost, ownership and complexity of the systems. By targeting the so called "low hanging fruit", such as control mechanisms, energy savings could be realized with minimal cost to the tenant. However, monitoring and verification of energy savings is needed before building owners/operators are convinced of the benefits and savings.

Project Description:

This project is developing a low-cost smart thermostat with a simplified user interface. Demonstrations are currently underway in low-income and senior housing, and the interface can be readily adapted to other building sectors, including small commercial. The smart thermostat will track user preferences and manage indoor conditions to optimize energy use. Internet connectivity is not required. By automatically optimizing thermostat settings, this project determines if smart thermostats can be a cost-effective method to address HVAC energy use in sectors where it does not make sense for building owner or tenant to make HVAC system upgrades.

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

This project bridges a technology connectivity gap in low-income and senior communities. Current smart thermostats are expensive, and a lack of broadband internet access makes these devices a bad fit for the low-income market. Developing a low-cost, internet-independent device creates opportunities to expand smart grid infrastructure and capture energy savings associated with automated controls in hard to reach building sectors.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: This project will leverage lower-cost hardware and software platforms to develop a cost-effective smart thermostat option of approximately $60. By providing a more cost-effective thermostat, this project could leverage utility and other incentives for a no-cost option for homeowners. By increasing adoption of smart thermostats this project will help lower energy use and costs from a generation and end-use level. At the end use level, smart thermostats have the potential to reduce HVAC energy use and costs by 10 to 15%.

Environmental Benefits: Development of a smart thermostat has the potential to reduce HVAC energy use. Energy saved at a building level means less energy required at a generation level, therefore potentially reducing the need to burn fossil fuels to generate electricity when renewable energy may not be available. The aggregate reduction in carbon dioxide (CO2) emissions imparted by the proposed thermostat just from low-income customers translates to approximately 175,000 metric tons. Including small commercial, emissions can be reduced by 218,000 metric tons.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$903,766

EPIC Funds Encumbered:

$2,705,759

EPIC Funds Spent:

$902,723

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $427,072 (13.6 %)

Match Funding:

$427,072

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 11

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Full scale pilot testing is ongoing with full participation. Over 100 tenants will test functionality over the two properties. Post installation data collection and the staged development of the user application is ongoing. Baseline data collection based on historical utility data is nearing completion.

Project Name: EPC-15-022 - Power Management User Interface

Recipient/Contractor: The Regents of the University of California, Irvine Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/1/2016 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Personal computers typically do not employ existing power management capabilities and are left on idle mode. This practice results in an increasingly large proportion of energy consumption in homes and businesses.

Project Description:

This project seeks to reduce energy consumption in personal computers by improving how users employ existing power management capabilities. Although all computers have the capacity to enter low-power modes such as sleep, and can be shut down when not in use, this potential for energy savings has not been realized in the majority of desktop computers. These computers remain on at full power when they are not used. The problem is one of user behavior. The project uses a software solution to change user behavior by changing the tool they are using. This approach is firmly based in behavior theory and human-computer interaction research, which have long demonstrated that the interface of a device can change users' behavior.

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

The Recipient developed an open source software call Power Management User Interface (PMUI) that is easy to use and provides feedback to the user on their energy use settings.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: Lower energy use results in reducing operating costs for consumers. The energy savings is estimated to be as high as 24 percent per computer, or about 129 kWh per year or up to approximately $20 per year. Many users feel they are "green" by using this type of software and doing their part for the environment.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$300,159

EPIC Funds Encumbered:

$785,124

EPIC Funds Spent:

$775,216

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 19 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 6

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project is complete. The research examined power management behaviors in a large sample of desktop computers. The recipient developed an open source power user management interface software. More than half of computers with sleep enabled experienced at least one problem with sleep transitions being blocked, and 27 percent exhibited substantially higher idle time and lower sleep time than expected. These sleep blockers reduced the effects of enabling sleep settings. However, treatment subjects still saved an average of 23.7 percent more energy than control subjects with no sleep enabled controls.

Project Name: EPC-15-024 - Efficient and ZNE-Ready Plug Loads

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/11/2016 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Plug load devices require the conversion of grid power from alternating current (AC) to direct current (DC) and these devices spend long periods of time in standby mode, creating inefficiency in current plug load devices. There is a need for energy efficient plug load technologies and strategies to reduce electrical consumption.

Project Description:

This project researches and develops new technologies and strategies to eliminate or significantly reduce energy use in standby mode by redesigning the power supply for plug load devices. This project also develops and demonstrates strategies to remove plug load devices from grid AC power by redesigning these devices to use DC power from photovoltaic power sources.

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

Standby power use is the electricity consumed by almost every electrical consumer device plugged in to an electrical outlet. Standby power is responsible for about 3 to 16 percent of residential electricity use. Earlier reductions in standby energy use by single devices have been offset by the growth in the number of devices having standby power use. This project is developing methods to reduce standby power use to zero or near zero. Saving 1 watt corresponds to 8.8 kWh/yr or about $1.50 per device. Developing an innovative family of zero-standby technology solutions and will enable the next generation of electrical devices to draw zero standby power while providing the full range of functionality that are desired by consumers.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: Implementation of the recommendations could lower the cost of electricity to the consumer by an estimated $750 million per year through the elimination of standby power and electrical losses from converting DC to AC.

Environmental Benefits: Implementation of the recommendations has the potential to reduce energy use up to 5,100 GWh/year, resulting in the estimated reduction of 1.2 million metric tons of CO2e.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$634,531

EPIC Funds Encumbered:

$1,600,000

EPIC Funds Spent:

$1,600,000

Match Partner and Funding Split:

EMerge Alliance: $50,000 (2.4 %)

Power Integrations: $75,000 (3.6 %)

Delta Electronics: $100,000 (4.8 %)

Lawrence Berkeley National Laboratory: $270,000 (12.9 %)

Match Funding:

$495,000

Leverage Contributors:

Southern California Edison: $500,000

U.S. Department of Energy: $400,000

Leveraged Funds:

$900,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 19 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project developed technologies to reduce standby power use to near zero watts. Burst mode, sleep transistors, wake-up radio, energy harvesting and storage combinations appear most promising for zero standby power. Coordinated improvements in efficiency, energy harvesting and energy storage will be best strategy to achieve zero standby power use. DC connected loads can be designed to connect directly to DC distribution, thus providing higher efficiency at lower cost. Networks of DC-powered devices can provide other benefits, such as resiliency during power outages. A unique category of energy using devices was identified that provide life safety, health and security to building occupants. The findings of the research were marketed to California based plug load devices manufacturers, as well as to the Energy Commission appliance standards office.

Project Name: EPC-15-025 - Plug Load Reduction App:RYPL

Recipient/Contractor: Home Energy Analytics

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 4/11/2016 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Plug loads or miscellaneous electrical loads (MELs) are the fastest growing category of residential electricity consumption and the idle load represents a surprisingly large percentage of the electricity used in California homes - on average 218 Watts across 70,000 homes. In addition, there is no accurate and reliable way to guide residents in choosing actions to reduce the idle load and no accurate way to track their progress if actions are taken to reduce the idle load.

Project Description:

This project researches methods to reduce home idle loads by utilizing smart meter analytics, an engaging smart phone app, a new online crowd-sourced database of miscellaneous electric loads, and an online efficient product marketplace to educate California residents about the idle load of their home and ways to reduce it. The system is to be piloted within all three electric investor owned utility territories and measure actual energy savings through smart meter data.

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

Idle load is a new concept to most residential energy users and includes appliances and equipment in the off or standby mode but still drawing power. The recipient has developed an innovative smart phone app called Dr. Power, which provides residents with information about their idle loads, provides ideas and a plan to reduce the idle loads, and correlates any energy saving actions with smart meter data. This simple to use app tests the theory that if accurate information about energy use is provided to consumers, they will be more likely to engage and take action. This technology has the potential to advance consumer knowledge and overcome barriers to reducing idle loads that could hinder the State's goal of doubling energy efficiency by 2030 and/or achieving zero net energy buildings in the future.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11
Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: Use of the Dr. Power app helps residential customers understand the energy use of their home appliances and electronics and provides ideas on how to reduce consumption. When residents take action, this could result in lower energy bills by an estimated 10% due to a reduction in idle loads.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$634,531

EPIC Funds Encumbered:

$884,100

EPIC Funds Spent:

$884,089

Match Partner and Funding Split:

Enervee Corporation: $300,000 (24.3 %)

Home Energy Analytics: $50,000 (4.1 %)

Match Funding:

$350,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 19 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Dr. Power was designed to and built to reduce residential idle load through user education and behavioral science. It was designed to incorporate smart meter data and measured standby power for specific devices. Over 800 PG&E and SCE customers created Dr. Power accounts. Across 341 PG&E Dr. Power Users, idle load was reduced by an average of 5.4 watts which equates to 47 kWh/yr. The open source database used by Dr. Power contains nearly 170,000 appliances. The public API has been used by three different applications including the AskDrPower.com, which is a unique and comprehensive on-line resource for exploring residential energy use. To have significant impact, more California residents need to know about Dr. Power. This can be done by including Dr. Power in statewide outreach programs, such as Energy Upgrade California, and for SCE and SDG&E to provide easy data access for their customers.

Project Name: EPC-15-026 - Unlocking Plug Load Energy Savings through Energy Reporting

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/1/2016 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Plug loads represent the energy used by hundreds of products, most of them electronics or small miscellaneous devices, and account for an increasing portion of electricity consumption in both residential and commercial buildings. Recent surveys indicate that plug loads are responsible for at least 25 percent of building electricity use nationally. Reducing plug loads has become a priority because as they proliferate and consume more electricity, emissions of greenhouse gases increase. However, building operators and end users do not have a clear or accurate tally of the plug load devices in their buildings, how much energy is used or how they could be better controlled to save energy.

Project Description:

This project is developing an interoperable protocol that can be implemented in all plug-load devices, unhampered by proprietary restrictions which will implement energy reporting to enable plug-load devices to transmit operating information - such as identity, power consumption, and functional state - through a communications network to a central entity. After a communication infrastructure is established for plug-load devices, the data flow can be reversed to send control signals to individual devices. The central management system that this project will demonstrate is well positioned to provide comprehensive control over diverse plug-load devices.

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

The recipient is developing inexpensive, proprietary-free technologies that can acquire energy use data for networked plug load devices and make them available to building owners. The technologies will be able to identify abnormally large plug load energy use and enable building owners to react to its energy use. The technology could be incorporated directly into California's building codes and other energy efficiency standards.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: In California, energy savings could exceed 2.6 TWh/year in residential and commercial buildings. More savings should result from applying the technology to other plug load devices such as appliances. The technology could result in a demand reduction of more than 300 megawatts. The energy savings could result in lower energy costs for consumers.

Environmental Benefits: The project could reduce energy consumption and greenhouse gas emissions by more than 1.7 gigatons per year.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$123,700

EPIC Funds Encumbered:

$1,630,699

EPIC Funds Spent:

$1,630,699

Match Partner and Funding Split:

Energy Solutions: $94,318 (4.4 %)

The Watt Stopper: $50,000 (2.4 %)

Lawrence Berkeley National Laboratory: $350,000 (16.5 %)

Match Funding:

$494,318

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 19 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

List of device types created by LBNL with funding from Northwest Energy Efficiency Alliance. Made available for use by UPnP (Universal Plug and Play) which has been since merged into OIC (Open Interconnect Consortium). This list will be recommended for incorporation into other technology standards.

Update:

The recipient demonstrated a set of devices with energy reporting features. The devices covered a wide range, including HVAC, lighting, a vehicle charger, a water heater, electronics (notebook computer and universal serial bus charger), and three external meters. To show these devices operating live, the team created a management system that queries the energy reporting devices for their data, stores the data, and displays it in compelling visualizations. The final report reviews existing communication protocols that support energy reporting and describes how to use them with a proposed reference data model for energy reporting. It also assesses ways that energy codes and standards processes can be leveraged to drive energy reporting technology into the market. The recipient continues to advocate energy reporting, recently forming a committee to revise the existing standard CTA-20147.

Project Name: EPC-15-027 - Electric Plug Load Savings Potential of Commercial Foodservice Equipment

Recipient/Contractor: Fisher-Nickel, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/16/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The main barriers preventing adoption of advanced appliances in commercial food service has been a combination of cost, the industry's lack of knowledge and energy data. An equally important barrier to the adoption of optimized energy mode technologies is the operator's apprehension that the appliance will not be ready to use when needed; that the amount of time required to heat the appliance will delay product delivery and hinder the "speed of service" to the customer. Another operator concern is that that product quality will suffer when this type of technology is applied to appliances that are designed to maintain food-safe temperatures.

Project Description:

This project assesses the reduction potential of electric commercial plug load foodservice equipment at 29 different commercial kitchens and demonstrates the potential for reduced energy consumption through the use of pre-commercial appliance designs and control technologies.

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

The project advancement is to bridge the knowledge gap and support the accelerated adoption of advanced appliances and controls by better understanding operator behavior and operational changes that can be made to successfully use new lower energy appliances. The results of this effort will be used to develop real world case studies of successful implementation of next generation plug load appliances, and provide training to food service operators to maximize energy reduction potential for food service equipment. In addition to food service operators, the research results will assist equipment manufacturers in further product development of energy efficient food service equipment and help justify development of utility incentives for purchasing and installing energy efficient foodservice equipment.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: This project could lower energy costs by encouraging the adoption and implementation of advanced design and controls for commercial food service plug load appliances that use less energy than conventional systems. This could save up to $467 in annual energy cost per plug load appliance, with savings up to 65% for replacements. Total savings on the equipment could total over $1,500 annually if energy saving controls were optimized for each appliance and the site has a combination of a vertical toaster, food warmer, espresso machine, hot plate, rice cooker, and soup warmer.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$392,763

EPIC Funds Encumbered:

$937,469

EPIC Funds Spent:

$708,837

Match Partner and Funding Split:

Fisher-Nickel, Inc.: $1,377 (0.1 %)

Pacific Gas and Electric Company: $148,623 (13.0 %)

Dalla Corte: $20,000 (1.8 %)

Nuova Simonelli: $18,350 (1.6 %)

Hatco: $4,100 (0.4 %)

NAFEM: $10,000 (0.9 %)

Match Funding:

$202,450

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 19 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project currently has 29 different sites. The recipient has collected baseline data at all sites and installed new equipment at 18 of these restaurants. Plug load meters were installed at each of the test sites to determine baseline electrical consumption. Depending on logistics and site flexibility, between two weeks and three months of baseline data was collected. The field data thus far showed that commercial foodservice plug load equipment has a wide range of energy intensities, based on the operation type and hours. Cumulative energy savings for all plug load equipment can be substantial. The appliance with the highest average daily energy use, the conveyor toaster, used more than 20 times the energy on average than the appliance with the lowest average daily energy use, the soup warmer. Frontier is also testing induction and conduction cook tops.

Project Name: EPC-15-028 - Real World Electrification Options of Energy Services and Environmental Justice (EJ) Considerations

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/13/2016 to 5/13/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Electrification of energy services that depend on fossil fuel combustion can create substantial benefits for California ratepayers and residents, including improved air quality, reduced greenhouse gas emissions, and significant cost savings. However, the cost-to-benefit ratio as well as distribution of benefits vary widely based on technology as well as the specifics of its application (e.g., location, use pattern). Understanding the magnitude and distribution of health benefits associated with electrification scenarios is critical to design and implementation of programs designed to achieve electrification objectives and address environmental justice issues.

Project Description:

The research team conducted a detailed study about the air quality implications of electrifying energy services such as transportation and space heating. The research team used, as a starting point, E3's prior EPIC study on *Deep Decarbonization in a High Renewables Future* (EPC-14-069). Estimates of how emissions of criteria air pollutants such as oxides of nitrogen and particulate matter would change with electrification were used as input to a sophisticated air quality model to estimate air quality impacts. The research team evaluated the implications of these air quality improvements on public health.

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

The analysis of health and air quality benefits alongside costs of electrification under this agreement is forming the basis for new cost-benefit metrics that can be used to assess the economic viability of breakthrough technologies. Cost-benefit analyses of this sort can be used to make evidence-based decisions regarding technology financing and deployment.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

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

Lower Costs: Electrification of customer energy technologies and services can create a number of benefits for California ratepayers and residents, including improved air quality, reduced greenhouse gas emissions, and significant cost savings. The project showed cost and benefits to utility customers of specific electrification technologies.

Environmental Benefits: This research provided information on the benefits of electrification for public health and the environment. Electrification of customer energy technologies, including homes, businesses, industry, and mobile sources can reduce greenhouse gas emissions. The final research results suggest that ozone and particulate matter concentrations would go down substantially in an electrification scenario, resulting in significant public health benefits.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$234,351

EPIC Funds Encumbered:

$799,444

EPIC Funds Spent:

$799,098

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $609,213 (39.1 %)

South Coast Air Quality Management District: $150,000 (9.6 %)

Match Funding:

$759,213

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

45 out of 45 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team delineated long-term electrification scenarios for the residential, commercial, and transportation sectors. For each scenario, researchers estimated emissions of criteria air pollutants at relatively fine geographical resolution and with the necessary temporal resolution for sophisticated photochemical modeling. Results suggest that electrification would result in substantial improvements in air quality and public health based on estimated reductions in maximum summertime 8-hour average ozone concentrations and wintertime PM2.5 concentrations. This analysis of health and air quality benefits alongside costs of electrification offers a basis for new cost-benefit metrics that can be used to assess the economic viability of breakthrough technologies

Project Name: EPC-15-030 - San Diego Regional Energy Innovation Cluster

Recipient/Contractor: Cleantech San Diego Association

Investment Plan: 2012-2014 Triennial Investment Plan, 2015-2017 Triennial Investment Plan

Project Term: 7/15/2016 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development, Market Facilitation

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies , S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

Clean energy startups face difficulties in making use of the existing programs and resources available in the area, and accessing technology validation facilities, business training, market intelligence, and capital. They also experience increasing challenges navigating regulatory barriers to development and commercialization of entrepreneur's innovations. In order to facilitate the development of new energy innovations and their entry into the market, the various entrepreneurial support services available in the region must be coordinated under one directive, optimizing key services to meet the needs of individual businesses.

Project Description:

Cleantech San Diego Association to establish a regional incubator program that leverages the region's universities, industries, businesses, economic development organizations, and other key stakeholder groups to support clean energy entrepreneurship in San Diego, Imperial, Riverside and San Bernardino Counties.

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

This project is advancing the goals of SB 350 (2015) by accelerating the commercialization of new clean energy technologies that can enable the integration of high-penetrations of renewables and distributed energy resources. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

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

Lower Costs: This project will help shorten technology development time and costs by providing a one-stop shop for entrepreneurs to quickly find and access the right services and resources.

Economic Development: This project will help facilitate successful clean energy entrepreneurship, leading to increased private sector investment and local job creation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$880,681

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$2,270,053

Match Partner and Funding Split:

Cleantech San Diego Association: $2,876,060 (35.5 %)

CONNECT: $221,874 (2.7 %)

Match Funding:

$3,097,934

Leverage Contributors:

U.S. Department of Commerce: $749,802

Leveraged Funds:

$749,802

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

6 out of 12 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the Southern California Energy Innovation Network (SCEIN) expanded the number of currently active startups in the program to over 25. These companies are developing innovations in areas such as storage technology, EV smart charging, and DER aggregation. Collectively, these companies have gone on to attract over $43.1 million in private follow-on funding and over $5.8 million in public follow-on funding since being accepted into the program, virtually doubling follow-on capital raised since 2018. SCEIN has also transitioned its Application Process to the new Empower Innovation Network platform which facilitates better integration with the rest of the Energy Innovation Ecosystem stakeholders and partners.

Project Name: EPC-15-031 - Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/2/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Consumer power consumption from electronic and miscellaneous plug loads pose large load profiles. Plug loads are not typically targeted by utility energy efficiency nor demand response programs. Consequently, plug load energy consumption and integrated plug load control strategies are not well-understood or developed. However, California's policies drive the need to better manage the growth.

Project Description:

This agreement develops integrated plug load control strategies for different spaces within multiple types of commercial buildings. The project implements a flexible energy management system (FEMS) to demonstrate the integrated control strategies for plug loads at pilot sites. This includes the installation of smart power outlets and integration of various plug load control strategies with building energy management and/or lighting control systems. The project demonstrates and measures the degree of effectiveness of the flexible control strategies developed for integrally managing operation of plug loads to achieve energy efficiency and demand reductions.

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

In order to reduce plug load energy use and increase the energy efficiency of buildings, this project advances flexible energy management systems coupled with smart power outlet technology to control plug load use. The project will also enhance integrated strategies for operating different plug load types to achieve energy efficiency and demand response. The results of this project can potentially reduce electricity use in commercial buildings, particularly during low-occupancy times and in user-assigned spaces, thereby achieving lower electricity costs for the ratepayer.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The developed cost-saving plug load control strategies will clarify display designs, control settings and incorporated behavioral considerations. The identified strategies could potentially reduce electricity use by 10% from plug loads, particularly during low-occupancy times and in user-assigned spaces. This would lead to a reduction in electricity cost of commercial ratepayers.

Greater Reliability: The developed technology will identify potential demand response strategies through coordinated operation of plug loads in an integrated building system environment. This could help support power and market systems, particularly during critical periods when the grid is stressed or prices are high.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$366,082

EPIC Funds Encumbered:

$1,050,022

EPIC Funds Spent:

$555,929

Match Partner and Funding Split:

Enmetrics Systems: $24,120 (1.7 %)

Ibis Networks: $51,000 (3.7 %)

SkyCentrics: $10,000 (0.7 %)

San Diego Gas & Electric Company: $30,000 (2.2 %)

To Be Determined: $30,000 (2.2 %)

TBD - Technical Writer: $25,000 (1.8 %)

Electric Power Research Institute, Inc.: $165,000 (11.9 %)

Match Funding:

$335,120

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 19 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team is evaluating the 1+ year of data collected to determine effectiveness in achieving energy efficiency and demand reductions with the plug load controls at both the lab and office demonstration sites. Select equipment types were time schedule controlled for energy savings such as the coffee maker in breakroom and centrifuges in biology labs. The project team is working on implementing functionality to engage demand response participation next. Preliminary data showed that energy savings from time scheduling was 80.31 kWh/year per smart outlet. The team is finalizing their development of a heat map display that identifies plug loads that are used more frequently in an office space. The display will show building owners where automated controls will have the biggest impact.

Project Name: EPC-15-032 - Bay Area Regional Energy Innovation Cluster

Recipient/Contractor: Activation Energy, Inc

Investment Plan: 2012-2014 Triennial Investment Plan, 2015-2017 Triennial Investment Plan

Project Term: 5/12/2016 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development, Market Facilitation

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies , S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

Long development times, high capital requirements, and long sales cycles for hard energy technologies have all contributed to an extremely difficult financing environment for hard energy innovators. In particular, venture capital investment, the main source of private sector support for early stage technology companies, has declined sharply for hard energy technology in the past several years. Unfortunately, no reliable, alternate source of private capital has emerged, due to the high risks associated with early stage energy technology development.

Project Description:

This project established the Bay Area Regional Energy Innovation Cluster by expanding the Cyclotron Road program to provide commercialization support services to Bay Area entrepreneurs developing breakthrough materials and hardware devices in energy efficiency, energy storage, distribution, grid management, and power generation. Cyclotron Road provides entrepreneurs access to world-class laboratory facilities, and key services, such as business model development, customer discovery, and intellectual property protection to enable energy entrepreneurs in the Bay Area region.

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

This project will help advance the goals of Senate Bill 350 (De Leon, 2015) by accelerating the commercialization of clean energy technologies, including energy efficiency, demand response, renewable generation, energy storage, and smart-grid integration. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed)

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

Lower Costs: This project will decrease the time and costs for new technology development by providing entrepreneurs with the services and facilities they need to commercialize their technology.

Economic Development: This project will help facilitate successful clean energy entrepreneurship, leading to increased private sector investment and local job creation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$282,411

EPIC Funds Encumbered:

$4,980,000

EPIC Funds Spent:

$1,566,120

Match Partner and Funding Split:

DLA Piper LLP: $90,000 (0.6 %)

Lawrence Berkeley National Laboratory: $4,150,000 (29.7 %)

Activation Energy, Inc.: $260,000 (1.9 %)

Autodesk, Inc.: $4,500,000 (32.2 %)

Match Funding:

$9,000,000

Leverage Contributors:

U.S. Department of Energy: $928,736

U.S. Department of Energy: $671,264

Leveraged Funds:

$1,600,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

6 out of 12 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, Cyclotron Road accepted its fifth cohort of fellows into its program. This latest round of entrepreneurs is developing innovations in areas such as AI for climate and weather risk forecasting, paintable optical coatings, and efficient cogeneration of hydrogen. The fellows will spend the next two years working on bringing their technologies closer to market. Fellows supported by CEC funding have attracted over $8 million in public and private follow-on funding since being accepted into the Cyclotron Road Program. Additionally, Activation Energy received a new grant philanthropic initiative Schmidt Futures, which will allow them to scale the Cyclotron Road fellowship model to new locations supporting more science entrepreneurs. In 2020, Cyclotron Road will accept its sixth cohort of fellows into the program.

Project Name: EPC-15-033 - Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/1/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Research indicates that many California classrooms are under-ventilated relative to rates specified in Title 24 and ASHRAE 62.1. Simply increasing outdoor air ventilation rates in classrooms has pitfalls: it will increase energy use, and it can have the unintended negative consequence of increasing student exposures to outdoor air pollutants. As California looks ahead to achieving 50% energy use reductions in existing and future ZNE schools, there is a need to demonstrate ventilation approaches that are substantially more energy efficient than current, minimally code-compliant systems.

Project Description:

The project includes three phases: 1) conduct energy and indoor air quality measurements in California classrooms to establish baseline data; 2) identify and install new, highly efficient HVAC technologies at selected schools and collect data from these schools; 3) conduct energy consumption and indoor air quality simulations based on information collected from previous two phases in representative climate zones in California, and compare simulation results with field data. The identified technologies in this study include heat recovery ventilators, air economizers, demand control ventilation, displacement ventilation, high-performance filtration, and learning thermostats. These are advancements that are over and above the technologies typically used in California schools, and can greatly improve the energy efficiency of providing heating, cooling, and ventilation in classrooms.

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

The project provides information on indoor air quality and energy usage in classrooms with current HVAC systems throughout different parts of California. It demonstrated the next generation HVAC system retrofits with regards to energy efficiency and indoor air quality performance. The results enable energy savings without impacting indoor air

quality in classrooms. The study is the first large field study to examine the energy efficiency and indoor air quality impacts after recent energy retrofits.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 4b, 5d

Lower Costs: By field testing several HVAC technologies that provide significant savings over existing systems, this project will result in energy savings from improved equipment performance and lower costs associated with delivering thermal comfort and improved indoor air quality in classrooms.

Public Health: This project will provide data on indoor air quality in classrooms that have both current and state-of-the-art HVAC systems. The results will enable future HVAC deployment in California that provides both energy savings and improved indoor air quality, improving the health of students at schools throughout California. Interim results will be used to educate schools about the steps they can take to improve ventilation in classrooms.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$439,287

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$1,132,490

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

45 out of 45 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is completed. In phase 1, the researchers collected indoor air quality (IAQ) monitoring, ventilation, and energy usage data from 104 classrooms in 11 schools using current HVAC systems. Researchers discovered high CO2 levels in some classrooms, suggesting poor ventilation, and worked with the CEC to provide schools tools and information to install, commission, and maintain systems appropriately. In phase 2, researchers installed and commissioned 2 next-generation HVAC systems on 2 schools. In phase 3, the team conducted simulation for schools built in 1998 and 2008. Results show energy savings and IAQ improvements from new HVAC systems. Use of high efficiency air filters significantly decreased PM2.5 levels without significant increase in ventilation energy. Researchers worked with manufacturers to fix issues with the new systems such as additional standby power consumption.

Project Name: EPC-15-035 - Clarifying and Quantifying Current and Near-Term Groundwater Pumping Energy Use and Costs in California to Improve Energy and Water Systems Reliability

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/1/2016 to 6/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The current lack of empirical research aimed at characterizing the relationship between energy use and groundwater pumping prevents accurate resource planning. Previous studies show that the water sector represents at least 7.7 percent of statewide electricity needs. The percentage of energy used for groundwater pumping is unknown. Similarly, the social barriers to decreasing pumping related energy use are poorly understood, as are options for overcoming those barriers.

Project Description:

The project is quantifying current statewide energy use and costs attributable to groundwater pumping and is developing near-term projections of energy use and statewide costs. The projections will factor in groundwater demand, groundwater levels, climate change scenarios, energy prices, and obstacles to implementing energy-efficient pumping and groundwater conservation measures. By expanding knowledge of the relationship between groundwater pumping and energy use, the project will enhance the ability of the State of California and irrigation and drinking water districts to coordinate water and energy resources planning. In addition, the project is providing key insights on how to improve groundwater use and pumping efficiency.

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

This study is quantifying current and near-term statewide energy use and costs due to groundwater pumping. Previous estimates of energy use for groundwater pumping likely underestimated the amount of energy used because of a lack of information on actual groundwater use. Due to recent regulatory changes, the availability of information on groundwater use has increased significantly. This information, combined with high-resolution modeling of hydrologic and climate change effects, will allow the researchers to produce more accurate estimates of current and future energy used for groundwater pumping. Benefits from this study will enable entities, such as investor owned utilities,

water agencies, and others, to increase the efficiency of the energy used in the water sector, inform demand side management strategies, and decrease greenhouse gas emissions.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 1f, 2a, 4c

Environmental Benefits: This study is quantifying current and near-term future energy use and costs for groundwater pumping. The study will inform conservation efforts to reduce groundwater use, which also reduces energy demand and intensity. Proper planning and conservation, such as reducing the pumping of groundwater in urban areas, could save 0.6 million acre feet of water per year, leading to annual savings of 120 gigawatt-hours. The team is also exploring institutional, economic, informational, and social barriers to decreasing the energy intensity of groundwater pumping, facilitating the implementation of energy and water conservation strategies.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$260,000

EPIC Funds Encumbered:

$625,000

EPIC Funds Spent:

$619,704

Match Partner and Funding Split:

Michael Hanneman: $22,550 (3.5 %)

Match Funding:

$22,550

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 7: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in 2019. The researchers found that, due to a warming climate, after 2050 there would be a significant increase in groundwater pumping and associated electricity use; some regions will experience a significant increase in groundwater use, such as a 42 percent increase in the Sacramento area by 2050, while other areas will have smaller increases. The researchers also conducted a survey of municipal and agricultural groundwater users to identify barriers to reducing energy used for groundwater pumping. The identified barriers include high initial capital investment, the availability of other more cost-effective operational measures, and the administrative and time intensity burden of incentive programs. The final report for this project is in preparation.

Project Name: EPC-15-036 - Probabilistic Seasonal and Decadal Forecasts for the Electricity System Using Linear Inverse Modeling

Recipient/Contractor: Eagle Rock Analytics

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/13/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Weather conditions are an important driver of demand for electricity. As California continues to move toward a zero-carbon, high-renewables electricity system, the need for improved weather data and information has increased. Hourly weather data is noisy, with frequent observing errors and instrumentation failures, making utilization of hourly data difficult. The CEC needs a reliable source of quality-controlled, accurate weather data to support demand forecasting and other activities. Additionally, seasonal forecasts of weather-related parameters associated with electricity demand can help support management of a high-renewables grid.

Project Description:

This project made three primary climate data advancements: (1) developed a curated, quality-controlled repository of hourly weather observations at 39 locations across California for the period 1973-2019, (2) provided recommendations for how to best use the data and supporting documentation, and (3) offered guidance on hosting a periodically updated database of quality-controlled, hourly temperature observations on Cal-Adapt. Data products utilized in this work supported development of a statewide data repository, providing energy sector stakeholders with regular ultra-high resolution data products that are needed to help California meet its renewable energy and climate goals. Additionally, the project assessed and quantified the extent to which the state of the Pacific Ocean can be used as a basis for generating predictions of temperature in California. The project then outlined an approach for making such predictions operational. The data and analyses produced and performed in this project meet the stated needs of investor-owned utilities, publicly-owned utilities, and state agencies to provide insight into the effects of sub-daily weather on the electrical system.

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

Investor-owned utilities and the CEC's demand forecasting group have historically utilized daily climate information to assess and plan for use response to weather. As the share of

power provided by intermittent renewable generation increases, and in tandem with the increasing availability of per-user sub-daily user consumption data, sub-daily weather information is increasingly necessary. This work provides a stable quality-controlled record curated for California's energy sector. Providing this information to energy system stakeholders through Cal-Adapt will facilitate a more stable energy system for California ratepayers, by (1) allowing utilities to better understand how diurnal weather variability and electricity use are related and (2) by providing for a centralized, publicly-available, regularly-updated database of quality-controlled data to be hosted on the Cal-Adapt platform.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 5c

Lower Costs: Improved weather data has the potential to allow for reduced cost of electricity if utilities can leverage information provided to improve supply and electricity acquisition purchase decisions. Additionally, access to a stable, quality-controlled database on hourly temperature may reduced costs to investor-owned utilities and energy planning agencies by avoiding the need for independent analyses and/or reliance on consultants for data cleaning.

Greater Reliability: This work provides a stable quality-controlled record curated for California’s energy sector. Providing this information to energy system stakeholders through Cal-Adapt will foster a more stable energy system for ratepayers, by allowing utilities to better understand how diurnal weather variability and electricity use are related. Further benefits to ratepayers are likely to emerge as this information can better inform infrastructure development compared to historical data.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$26,898

EPIC Funds Encumbered:

$400,000

EPIC Funds Spent:

$399,999

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 10: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the research team improved and optimized forecasting algorithms; processed and analyzed hourly weather data for trends and relevant quantities; reviewed peer-reviewed atmospheric science literature to identify additional determinants of predictability in seasonal temperature; produced and uploaded datasets for use by the CEC's Demand Analysis Office, the Cal-Adapt development team, and other energy sector stakeholders; and participated in a final meeting in which technical results were shared with the Demand Forecast Office. Finally, the research team submitted a final report for publication, began work on a peer-reviewed publication, and participated in knowledge transfer to support a workshop where hourly data will be discussed by IOUs, CEC, CPUC, and other energy sector stakeholders to illuminate how best to provide access to the data on Cal-Adapt.

Project Name: EPC-15-037 - Smart Ventilation for Advanced California Homes

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/13/2016 to 1/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

As California works to increase the amount of intermittent renewable energy penetration operating in its electricity infrastructure, there is a growing need for services that can compensate for that intermittency such as demand response. Smart home ventilation systems are a potential area for such a contribution.

Project Description:

This study explores how real-time monitoring and automatic controls can be used in home ventilation systems to improve energy efficiency and/or optimize consumption for time of day load balancing. Specifically, the study considers optimization of ventilation for indoor air quality for zones (i.e., air quality in different rooms within buildings). The study is being done via software simulation, in multiple well-established platforms, to develop and evaluate control schemes for home ventilation systems. Key evaluation criteria are the modeled ventilation-related energy used over a year of operation, and the IAQ relative to a minimally code-compliant continuously operating ventilation system.

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

This work builds on efforts of the past decade that have facilitated dynamic ventilation approaches. The project uses informed simulation approaches to determine how energy, IAQ, demand, and comfort can be optimized using smart ventilation. The results from the project will help smart home automation service providers and their consumers identify effective smart ventilation strategies and provide important, as well as provide information that the Energy Commission could potentially use in development of future ventilation standards.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 4b, 5d

Lower Costs: The project has the potential to result in reduced electricity consumption and/or peak shifting by developing smart ventilation strategies to optimize system performance.

Public Health: The project has the potential to result in in improved air quality in homes that utilize the smart systems developed.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$649,037

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$1,500,000

Match Partner and Funding Split:

United States Department of Energy: $1,000,000 (35.7 %)

Aereco S.A.: $200,000 (7.1 %)

Lawrence Berkeley National Laboratory: $100,000 (3.6 %)

Match Funding:

$1,300,000

Leverage Contributors:

U.S. Department of Energy: $1,000,000

Leveraged Funds:

$1,000,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team completed several journal publications based on literature review and developed guidelines for IAQ metrics. Metrics have now been used in a U.S. Department of Energy (DOE) project in the development of a home IAQ scoring system. Key technical work for this project is to develop an integrated energy simulation model that includes smart ventilation technology. The simulation work is ongoing. The team also developed a range of optimized control algorithms for various home ventilation scenarios based on occupancy, timers, and weather conditions. The integrated simulation model includes both an air flow and contaminant transport model, CONTAM, managed by the National Institute of Standards and Technology; and a building energy model, managed by DOE. Residential building types used in the models were represented as compliant with California Energy Code.

Project Name: EPC-15-038 - BlueTechValley Innovation Cluster

Recipient/Contractor: California State University, Fresno Foundation

Investment Plan: 2012-2014 Triennial Investment Plan, 2015-2017 Triennial Investment Plan

Project Term: 5/16/2016 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development, Market Facilitation

S10: Leverage California's Regional Innovation Clusters to Accelerate the Deployment of Early Stage Clean Energy Technologies and Companies , S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

While Central Valley entrepreneurs are helping to drive new and effective energy and water innovations, many are still limited by technical and non-technical hurdles on the road to commercialization. On their own, many do not have sufficient resources to fully test their technologies, develop fundable business plans, grow entrepreneurial networks, or transition technologies from trial or demonstration scale to real-world deployment and commercialization. The need to help such entrepreneurs is magnified by the recent drought conditions in the Central Valley that have critically reduced available surface water supplies and increased electricity demand due to increased groundwater pumping.

Project Description:

This project expands access for clean energy entrepreneurs to a region-wide energy-water-food nexus incubator and commercialization services in California's Central Valley and North State regions. The Central Valley Energy Innovation Cluster (a.k.a. BlueTech Valley Energy Cluster) provides entrepreneurs with a variety of services, including technology evaluation, proof-of-concept validation and advisory support as well as opportunities to connect with investors, industry leaders and potential customers.

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

This project will help lead to technology advancements by providing and coordinating key services, assistance, resources, and infrastructure needed by entrepreneurs and researchers to create and develop advanced energy technologies that will help the state meet the targets set by Senate Bill 350 to increase both renewable electricity generation and energy efficiency to 50 percent by 2030.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 2a, 3e

Economic Development: This project helps facilitate successful clean energy entrepreneurship, leading to increased private sector investment and local job creation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$718,347

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$1,819,852

Match Partner and Funding Split:

California State University, Fresno Foundation: $2,350,112 (30.7 %)

Child Family Institute for Innovation and Entrepreneurship - UC Davis: $200,000 (2.6 %)

Schatz Energy Research Center: $35,772 (0.5 %)

Los Angeles Cleantech Incubator: $19,900 (0.3 %)

Kern Economic Development Corporation: $49,900 (0.7 %)

Match Funding:

$2,655,684

Leverage Contributors:

U.S. Department of Commerce: $500,000

U.S. Department of Commerce: $300,000

Leveraged Funds:

$800,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

6 out of 12 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

BlueTechValley (BTV) has accepted and supported 179 companies (66 companies in 2019) which received $8.2 million in follow-on private capital and $4.85 million in follow-on public funding in 2019. To date, BTV companies have received $36.4 million in follow-on private capital and $13.14 million in follow-on public funding.

BTV hosted or supported over 50 events in 2019 to support entrepreneurs including grant-writing workshops, CEO Crash Course Boot Camps and the Central Valley Clean Tech Showcase.

In 2020, outreach activities will focus on four key areas: 1) work with each Hub to identify and conduct events throughout the region on funding, product design, business development and industry trends; 2) build regional connections with entrepreneurial, community and research organizations; 3) conduct a major energy conference in spring 2020; and 4) expand program resources through each Hub.

Project Name: EPC-15-039 - Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/24/2016 to 2/28/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Deserts are impacted by both the development of large scale solar installations and the temperature changes associated with human induced climate change. The effect of these impacts on the soil organic (biomass) and inorganic (calcium carbonate) carbon budget is unknown. It is crucial to gain quantitative understanding whether desert ecosystems will lose carbon as a result of both solar field installations and climate change, as well as to identify the environmental costs and benefits of renewable energy development in terms of greenhouse gas (GHG) emissions.

Project Description:

This project installs soil and meteorological sensors at sites with solar installations and in adjacent undisturbed areas to make direct comparisons on the gains or losses of carbon, changes in microclimate and hydrology, and changes in dust generation or capture, and is aiming to predict long term soil and GHG emissions changes based on geochemical modeling. The project addresses the question of whether land alteration and modification during the construction and use of solar installations has a measurable impact on the soil carbon balance, and ultimately on the net carbon savings that solar installations provide during their lifetime.

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

The research project -- the first of its kind -- is determining the impact of large solar arrays on the carbon storage of desert soil ecosystems. Findings will provide insights into the most effective ways to design and manage solar production facilities for maximum net carbon benefits.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 2a, 4f

Lower Costs: The proposed research estimates the mass (and market-based value) of net carbon change in desert soils due to solar site development and climate change. These metrics for soil carbon gains and losses could be incorporated into renewable energy credits (RECs) and would constitute a direct monetary benefit to California IOU ratepayers.

Environmental Benefits: The proposed research estimates GHG emissions arising from net changes to the natural soil carbon cycle caused by utility scale solar installations, reduces regulatory uncertainty, and facilitates more efficient environmental approval procedures for solar energy companies, which helps to meet the state's renewable energy goals.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$80,312

EPIC Funds Encumbered:

$499,181

EPIC Funds Spent:

$31,720

Match Partner and Funding Split:

The Regents of the University of California, Berkeley: $72,000 (12.6 %)

Match Funding:

$72,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team continuously collected tropospheric climate and physical and biological soil data at six undisturbed sites within the Mojave National Preserve. Chemical, physical, and organic and inorganic carbon measurements were completed on all soil samples collected from the six sites. Data from the sites has been used to parameterize the DayCent ecosystem process model. Installation and sampling of two in-situ monitoring stations located at a utility-scale solar facility was completed in 2018. Data collection of temperature, water content, and corresponding CO2 concentrations continued through 2019. The Final Report was submitted.

Project Name: EPC-15-040 - Assessing California's Mitigation Guidelines for Burrowing Owls Impacted by Renewable Energy

Recipient/Contractor: Zoological Society of San Diego dba San Diego Zoo Global

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/24/2016 to 9/2/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

In California, western burrowing owls (*Athene cunicularia hypugaea*) have been designated with the conservation status of Species of Special Concern, mainly due to habitat loss. With planned facility expansions in burrowing owl habitat, renewable energy projects represent a possible stressor for the species. Translocation away from project sites is an important mitigation method for owls impacted by development, but there has been significant uncertainty around the effectiveness of the main two approaches (active and passive translocation) due to the difficulty of tracking owls long enough to determine their fates after they were released.

Project Description:

The project analyzed the consequences of both passive and active relocation methods for burrowing owls (a California Species of Special Concern), and filled an existing need for robust scientific data on the relative effectiveness of relocation as a conservation method. Secondary goals were to provide data on owl movements and habitat use that could inform collision risk models and site selection decisions for renewable energy-generating facilities. The project team fit more than 50 owls with GPS tracking devices and divided them into three study groups--active translocation, passive relocation, and a control group. Frequent site visits provided information on mortality rates and reproductive output.

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

This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on burrowing owls. This was achieved by evaluating the relative effectiveness of primary translocation methods in an experimental framework. Improvements to the effectiveness of existing translocation methods were tested experimentally. Long-term GPS tracking of individuals in the active and passive relocation groups and a control group provided the critical, previously missing, information to judge the effectiveness of each method. The management recommendations and proposed

translocation protocols from this study should improve the success of mitigation and facilitate new permitting of renewable energy.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4f, 4g

Environmental Benefits: The project measured the relative effectiveness of alternative methods for translocation of burrowing owls that are displaced from renewable energy development areas. This should lead to better guidelines for mitigating impacts on this California Species of Special Concern. The project produced management recommendations to the wildlife regulatory agencies to improve the success of owl translocations.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$54,425

EPIC Funds Encumbered:

$598,671

EPIC Funds Spent:

$440,675

Match Partner and Funding Split:

Western Riverside County Regional Conservation Authority: $127,315 (10.6 %)

United States Department Fish and Wildlife Service: $35,022 (2.9 %)

Zoological Society of San Diego dba San Diego Zoo Global: $407,161 (33.9 %)

Coachella Valley Conservation Commission: $33,438 (2.8 %)

Match Funding:

$602,936

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

45 out of 45 bidders

Rank of Selected Applicant/ Bidder:

Group 6: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project was completed in 2019, and the final report was received. The researchers captured the targeted number of burrowing owls at development sites for three treatment groups. They released the active translocation group of owls at conservation areas and monitored their mortality and reproductive success. Short-term survival after translocation was relatively high, with no apparent reduction in reproduction. In collaboration with the Technical Advisory Committee, the project team refined the study design and research protocols and made recommendations to wildlife regulatory agencies about translocation protocols. In addition, they tested GPS units and modified their design for use with burrowing owls. The team shared sample material from captured owls with researchers in EPC-14-061 and EPC-15-043 to extend the data used for isotopic and genetic analyses in those projects.

Project Name: EPC-15-041 - MarketZero: Taking an existing grocery store to scalable near-ZNE

Recipient/Contractor: Prospect Silicon Valley

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Supermarkets and grocery stores have the highest energy use among commercial buildings with majority of energy spent on refrigeration and other miscellaneous loads. They are also the most challenging to achieve zero net energy among commercial buildings. This is due to the high process energy use of refrigeration, lighting and commercial kitchen systems.

Project Description:

The project implements a cost-effective energy efficiency upgrade package for a grocery store that uses both mature and innovative energy efficiency technologies with the objective of converting all major gas using equipment to electric.. The project includes LED lighting and refrigeration system improvements to increase energy efficiency, changing refrigeration units to use a lower global warming potential refrigerant (R448A), and installing high-efficiency variable frequency drive compressors. Other improvements include thermal ice packs in the walk-in freezers to reduce compressor run time during the day and help shift electrical load on hot days, variable speed reluctance motors for the supply fans for new efficient heat pumps, and self-contained refrigeration cases to improve the efficiency.

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

As grocery store owners are risk averse especially with new emerging innovative technologies, successful demonstration showing the benefits and performance of an all-electric grocery store, could advance these technologies for use in other grocery stores. As profit margins for grocery stores are between 1 and 3 percent, increases in energy efficiency using these advanced technologies will be beneficial to a store's bottom line. Also, these types of improvements pose challenges to grocery stores due to limited space and existing configurations. However, documenting cost, savings and benefits could influence the grocery market to make similar future upgrades. These solutions and design approaches hope to reduce greenhouse gas emissions and decarbonize grocery stores.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: Implementing the energy efficiency upgrade package could lower future energy costs for building owners and operators and is applicable to other grocery stores. Estimated state-wide reduction of about $400 million (based on savings of 2,400 GWh and 15 million therms) across California grocery stores.

Environmental Benefits: Replacing all natural gas using systems with high efficiency electric units (e.g., heat pumps) could lead to additional grocery stores decarbonizing in the future to reduce their greenhouse gas emissions. Also, as grocery stores have a high number of refrigeration units, replacing these units with ones using lower global warming refrigerants will result in further reductions in greenhouse gas emissions.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$846,723

EPIC Funds Encumbered:

$2,999,591

EPIC Funds Spent:

$1,346,168

Match Partner and Funding Split:

Whole Foods Market: $650,000 (17.8 %)

Match Funding:

$650,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 5: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

All projects have been installed and are now being monitored. The demonstration site is Whole Foods in San Francisco. The store has installed a sound barrier to address sound levels from the new heat pump system. Controllers are being programmed for the reluctance motors. These motors work with the supply air on the new heat pumps. Draft final report is under development.

Project Name: EPC-15-042 - Zero Energy Residential Optimization - Community Achievement (ZERO-CA)

Recipient/Contractor: California Homebuilding Foundation (CHF)

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/1/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development

Issue:

Although the construction of a number of single (one-off) Zero Net Energy (ZNE) homes has established that this is a technically feasible goal, it is less clear whether ZNE construction can cost-effectively be brought to scale, especially within the context of the Title 24 Building Energy Efficiency Standards. There is a need for significant increase in the efficiency of California new construction - without significant increases in cost. Additionally, the State will need improved methods for estimating and controlling the unregulated loads, which have grown and will continue to grow over the coming decades.

Project Description:

The project serves as proof of concept for large-scale deployment of Zero Net Energy (ZNE) single-family homes in California. The objective is to construct ZNE homes without creating undue cost burdens on builders, businesses or consumers, while assuring that changes to home design do not pose health, safety or other risks to occupants. The project also provides industry and regulators with a better understanding of site energy use and renewable energy generation.

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

Working closely with the builder and subcontractors, technology costs will be evaluated and will include a real-world perspective by providing actual time and labor spent to install and commission each of the new technologies versus only the technology cost. By providing this data and analysis, this project will serve as a roadmap toward the most effective ways to implement ZNE homes. The information gathered will be disseminated through various project participants such as California Building Industry Association (CBIA) events and member newsletters in efforts to promote the potential for cost-effective ZNE to the builder community.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The project will focus on cost control for ZNE construction by developing cost-effective packages of measures that include both commercially available and emerging technologies that meet the requirements of the Building Energy Efficiency Standards (Title 24, Part 6) as well as unregulated measures. Examples of unregulated measures include appliances, and plug load. In addition to builder cost savings passed to consumers in sales price, the project will assess and optimize actual consumer utility cost savings from ownership of ZNE homes.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,488,701

EPIC Funds Encumbered:

$4,819,805

EPIC Funds Spent:

$2,063,803

Match Partner and Funding Split:

California Homebuilding Foundation (CHF): $2,611,014 (35.1 %)

Match Funding:

$2,611,014

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 6: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project continues to construct and sell ZNE Homes. The Recipient is in the process of preparing the final report. A small subset of homes (10-15) have begun monitoring and data collection activities. Work is ongoing to analyze the preliminary data sets.

Project Name: EPC-15-043 - Development of a Genoscape Framework for Assessing Population-Level Impacts of Renewable Energy Development on Migratory Bird Species in California

Recipient/Contractor: The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/3/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

While renewable energy facilities offer clean alternatives to our growing energy needs, they have recently come under scrutiny for their impacts on native wildlife. In particular, tens of thousands of protected birds are killed at solar and wind facilities each year. Assessment of the overall impact of these facilities has been hampered because 1) population-level distributions are poorly understood (i.e. do killed individuals come from vulnerable populations?) and 2) current methods for identifying migration routes have low resolution and are extremely costly.

Project Description:

This project developed a low-cost method to create high-resolution spatial maps of bird populations and migration routes that capitalizes on genomic data. This technology was extended to identify migration routes for additional vulnerable and endangered species, assess population-level impacts of fatalities at renewable energy facilities, and map migration hotspots. This information can help with siting decisions of new facilities as well as operational decisions, such as when to turn off wind turbines to avoid vulnerable population fatalities, reducing the overall number of bird losses at renewable energy facilities. Accurate understanding of the distributions of vulnerable populations in space and time will lead to more effective siting, monitoring, and operation, ultimately lowering costs to California ratepayers.

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

This project harnessed the power of genomic data to develop genetic assays for quick, low-cost screening of thousands of individual birds. Researchers created high-resolution maps of population structure and migration routes and applied this information to assess population-level impacts by screening carcasses collected from renewable energy

facilities. Genoscape maps were merged with existing spatial data of energy potential to make recommendations for siting new facilities in areas with minimal impact on wildlife.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4g

Environmental Benefits: Improved mapping of migration timing and routes of bird populations of concern may inform renewable energy siting decisions by solar and wind developers, and help them target mitigation strategies.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$114,848

EPIC Funds Encumbered:

$599,236

EPIC Funds Spent:

$532,742

Match Partner and Funding Split:

Regents of the University of California, Los Angeles: $888,250 (59.7 %)

Match Funding:

$888,250

Leverage Contributors:

Santa Clara Habitat Valley Habitat Agency: $46,366

National Science Foundation: $105,371

U.S. Department of Defense: $147,579

Leveraged Funds:

$299,316

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 6: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project was completed in 2019, and the final report was received. The researchers developed maps and schedules of the migration routes (genoscape maps) of distinct populations of four birds (Common Yellowthroats, Wilson's Warbler, Burrowing Owls, and American Kestrel) relative to renewable energy sites. Samples from bird carcasses killed at solar and wind facilities were assessed by the genetic methods to estimate the population-level effects. The results support the idea that the majority of individuals exposed to renewable energy development were from the largest genetically distinct populations within each species, whereas carcasses from rare and declining populations made up a smaller percentage of the total number of birds sampled. Prioritization of renewable energy siting varied by the taxonomic groups. Multiple journal articles are being written.

Project Name: EPC-15-044 - Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 8/15/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Operational Tools, Models, and Simulations to Improve Grid Resource Planning

Issue:

Revisions being made to Rule 21 require grid-supportive functionality and communication interfaces, and the revisions specify the IEEE 2030.5 communication protocol for monitoring and managing distributed energy resources (DER). This protocol is complex, making the development of products difficult and putting interoperability at risk. The application of the IEEE 2030.5 protocol to DER is new, and certification procedures and test software for this application do not exist. These challenges translate to delays in the availability of products and programs that provide grid support opportunities, which prevents owners of DERs to realize additional value of their asserts from grid services.

Project Description:

This project developed two key open-source software technologies: 1) implementation of a complete, certified IEEE 2030.5 communication protocol that manufacturers can freely incorporate into their products. This reduces the cost and complexity of bringing systems to market, streamlines the certification process, and helps ensure that products can successfully connect and participate in grid programs; and 2) a certification procedure and associated test software by which any system or device can be checked for compliance to the standard. Independent evaluation provides manufacturers with an unbiased assessment of their products and provides both business and individual consumers with assurance that their purchases will work as expected. The project also validated the completeness and quality of these technologies by implementing the open-source client in a commercial DER system and performing field testing.

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

This project helps accelerate availability and connection of DER products and systems in California that meet Rule 21 requirements. This also helps more rapidly increase grid-tied solar generation to meet California's aggressive solar mandates.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1a, 1h, 1i, 2a, 3a, 5a

Lower Costs: The cost of product development and system integration is reduced through the availability of free open source software. These cost savings are reflected in retail costs and program incentives that directly benefit California ratepayers. The recipient estimated that the open-source software will enable $1-2 million of cost savings per DER manufacturer by eliminating the need to develop, test, integrate and certify proprietary software.

Energy Security: Emergency backup power and smart home systems that aid consumers during disasters become practical because of the accessibility and interoperability of systems provided by a successful open communication protocol.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$203,973

EPIC Funds Encumbered:

$816,539

EPIC Funds Spent:

$806,503

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $92,153 (8.7 %)

Enphase Energy: $24,000 (2.3 %)

QualityLogic: $32,519 (3.1 %)

SunSpec Alliance: $65,050 (6.1 %)

Xanthus Consulting International: $30,000 (2.8 %)

Match Funding:

$243,722

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

23 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project completed in March 2019. The final report *Certified Open Source Software to Support the Interconnection Compliance of Distributed Energy Resources* was received. Four different product vendors have implemented the open sourced IEEE 2030.5 client. The software integrates with their commercial gateways, or facility energy management systems to provide a Rule 21 compliant interface to utility operations. Several others are currently testing the viability of incorporating the open source software in their products.

Project Name: EPC-15-045 - Transactive Incentive Signals to Manage Electricity Consumption for Demand Response

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/18/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

Demand response (DR) has substantial potential to act as either a demand-side or a supply-side resource. However, existing programs and rates do not provide a participation incentive structure that accurately reflects system conditions or system costs, a suboptimal situation that results in higher ratepayer costs, low DR participation and an inability for system operators to regularly utilize demand-side resources. As the state moves toward more distributed generation and intermittent renewable energy generation, integration of those generation resources will further increase costs in the absence of significantly expanded DR resources responding to actual system needs in real time.

Project Description:

This project develops Transactive Load Management (TLM) signals, expressed in the form of proxy prices reflective of current and future grid conditions, and develops and implements software to calculate such signals. These signals are being designed to provide customers sufficient information to optimize their energy costs by managing their demand in response to system needs. The signals are transported via proven and available protocols and networks for use by projects that will test the efficacy of the TLM signals using the demand response projects awarded under GFO-15-311, Advancing Solutions that allow Customers to Manage Their Energy Demand.

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

This project has developed a day-ahead hourly proxy price signal that incorporates system conditions as reflected by wholesale energy markets. The hourly prices are being made available on a publicly-accessible server and are being incorporated as one of the experimental pricing structures being evaluated in EPIC demand response projects funded under GFO-15-311. The experimental pricing structures assessed the potential for a variety of different loads and customer types to respond automatically to a real-time

proxy pricing signal, and by extension, the potential of DR being a demand side or a supply side resource for the State.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 (closed) Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

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

Lower Costs: Demand response lowers costs for both the system and individual customers. Procurement costs are reduced when wholesale energy prices are attenuated by price-responsive demand; customer costs are reduced when they either shift consumption to lower-priced times or receive payment for participating load reduction.

Greater Reliability: High levels of demand can stress grid assets, and increased stress could lead to outages if left unchecked. To the extent that a TLM signal and smart management of consumer loads can minimize stress on grid equipment, reliability is improved.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$190,201

EPIC Funds Encumbered:

$498,054

EPIC Funds Spent:

$443,169

Match Partner and Funding Split:

Greenlots: $110,450 (18.2 %)

Match Funding:

$110,450

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 21 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project has completed all technical deliverables. The agreement was extended to March 31, 2020 to allow the recipient to continue to support the Transactive Load Management signal for use by the other agreements awarded under GFO-15-311.

Project Name: EPC-15-046 - Developing a Distribution Substation Management System

Recipient/Contractor: Siemens Corporation

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/24/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

As the electric distribution system becomes increasingly complex with the integration of more distributed energy resources, existing distribution automation systems need to be enhanced with functions to manage increasing amounts of renewable energy connected at the distribution level and to provide greater control over the operation of distributed energy resources. Distribution management systems need to automate more monitoring and control operations at substations using standard communication protocols to quickly respond to changes and problems to reduce outage times.

Project Description:

This project developed a software which can display the current state of the distribution system, detect problems, and automatically suggest potential solutions to reduce outage times. The software also helps automate routine and non-routine engineering and maintenance tasks that are performed on substation equipment, such as monitoring voltage violation.

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

Highly automated and efficient grid operation is required to achieve California's energy goals, in particular with respect to the Clean Energy and Pollution Reduction Act of 2015 (Senate Bill 350) that strives to reach 50 percent renewable energy resources. This project can lead to technological advancement and breakthroughs to overcome barriers in electrical grid automation by demonstrating the potential of semantic technologies for categorizing and processing data, as well as for discovering relationships within a varied data set. This system allows operators to control and further automate routine and non-routine engineering and maintenance tasks that are performed on substations. By making the complex smart grid more accessible for operators, it permits faster resolution of outages, thereby making the grid more maintainable and resilient.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

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

Lower Costs: A greater degree of automation for grid operation processes leads to reduced grid operation costs that potentially translates into lower rates for California ratepayers.

Greater Reliability: This project developed a software that allows certain grid problems to be resolved automatically, thus reducing power outages.

Energy Security: A greater degree of grid automation enables faster reactions to shifts in electricity production, thereby permitting a higher percentage of distributed renewable energy resources.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$171,526

EPIC Funds Encumbered:

$500,000

EPIC Funds Spent:

$499,999

Match Partner and Funding Split:

Siemens Corporation, Corporate Technology: $455,000 (47.6 %)

Match Funding:

$455,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

23 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project completed in March 2019. The final report, *A Semantically Integrated Operational Dashboard for the Management of Smart Grid* was received. The Siemens Corporate Technology team is actively looking for partners within Siemens and the utilities in California to run a pilot project to conduct user studies of the developed dashboards with grid operators.

Project Name: EPC-15-047 - Powernet - A Cloud Based Method for Managing Distribution Resources

Recipient/Contractor: SLAC National Accelerator Laboratory

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/18/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

The power grid is changing rapidly. In California, renewables on the utility side of the meter are expected to provide 50% or more of the electricity supply by 2030, requiring significant distributed energy resources (DERs) to help integrate those renewables. Additionally, greatly expanded numbers of DERs, such as distributed solar, storage, and EVs, are expected on the customer side of the meter and on the utility side of the distribution grid. There is an urgent need to coordinate all these resources to minimize costs, increase consumer quality of service, preserve grid stability and offer services to the grid.

Project Description:

This project will further develop Powernet, a cloud-based platform for managing energy resources in homes and businesses. Powernet will control and coordinate energy resources both behind the meter and at the distribution system for residential and commercial ratepayers to: (i) minimize costs, (ii) increase consumer quality of service, (iii) preserve grid stability and (iv) offer services to the grid.

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

Several significant Powernet system innovations will be developed under this agreement: (i) The integration of control, optimization and power electronics will enable novel functionality that includes stable connect/disconnect from the grid, local and global power sharing, and grid services including demand response; (ii) The layered structure of the system will enable the operator to utilize Powernet for a variety of different grid purposes or service offerings with the assurance that those are always done on top of an economically optimal operating point every second; (iii) The system will be robust and secure by design; and (iv) The system will adopt open source standards and protocols for the platform to enable scalable engagement of devices in the future.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1g, 2a, 3a, 3d, 3f, 5f, 5h

Lower Costs: There will be economic savings to using Powernet. Every home and business will need to pay only once for installation of the Powernet and can then progressively add DERs on its own. The cost of adding more DERs, at a home or facility, can be reduced by 5 to 10 percent by using Powernet because additional DERs can be easily integrated without extra labor.

Greater Reliability: Powernet will allow for greater control of a diverse set of behind-the-meter resources, which will enable greater reliability of the grid.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$865,939

EPIC Funds Encumbered:

$2,210,720

EPIC Funds Spent:

$2,210,720

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $3,500,000

Leveraged Funds:

$3,500,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

23 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team continues to make progress on the project deliverables and installation of batteries, inverters, charging stations, rooftop solar, and metering equipment. The Deployment Report was submitted in August which covered customer recruitment, permitting, test simulations, and final implementation. Equipment was installed at 11 residential homes in the City of Fremont. The recipient submitted the draft final report in October, ahead of the projected November deadline.

Project Name: EPC-15-048 - Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources

Recipient/Contractor: Alternative Energy Systems Consulting, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

Excessive variable solar generation during the daytime is challenging for grid operators due to the steep ramp up and down in the morning and evening. Significant contribution from renewables cannot be realized unless there is a transformation of how energy is being managed, especially as the electrical grid moves more towards a complex mesh of millions of distributed generators. An effective solution for integrating distributed generators with energy storage, managing loads, and utilizing excess production during periods of peak generation is needed.

Project Description:

This project tests and validates an intelligent residential energy management system that is capable of communicating with a variety of distributed energy resources (DER) including solar PV and energy storage in 100 residences in San Diego. The project integrates the use of pilot time-of-use utility rates in conjunction with simulated dynamic pricing signals to optimize grid impact and cost savings.

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

The key advancement in this project will be the operational integration strategies being developed and tested in the field. If proven successful through field testing, this system has the potential of achieving widespread deployment throughout the state which could significantly reduce peak demand, reduce annual energy costs, and improve grid operations.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1e, 1h, 2a, 4a

Lower Costs: Based on initial estimates, implementation of the energy management system could reduce annual customer electricity costs by 36 to 41 percent by enabling residents to use the majority of their electricity when energy rates are the lowest.

Greater Reliability: The integration and communication of distributed energy resources across millions of homes can provide greater electricity grid flexibility, which allows greater renewable penetration while reducing outage risk.

Environmental Benefits: A solution that enables ratepayers/customers to use higher levels of renewable energy generation will help reduce GHG emissions.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$637,870

EPIC Funds Encumbered:

$3,996,560

EPIC Funds Spent:

$3,258,017

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 21 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Progress this year includes completing installations with all equipment operating and collecting data, completed production readiness plan, technology/knowledge transfer plan, and draft final report. Project team continues to analyze field test data.

Project Name: EPC-15-050 - Winery Water and Energy Savings

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California is the fourth largest producer of wine in the world. The California wine industry is a significant water consumer and is the second largest consumer of electricity among the food and beverage industry. As the wine industry and its associated water and energy use continue to expand, efficiency technologies will become increasingly important. Water supply is limited and energy bills will become a larger portion of operating costs if not contained. Water reuse and novel heat recovery can significantly decrease fresh water use in wine production while decreasing energy use, but data on technical and economic feasibility is limited.

Project Description:

This project is testing two energy and water saving technologies at a winery facility in northern California. The first technology is a water treatment and reuse system to recycle wastewater for indoor barrel washing. The second is a wine-to-wine heat exchanger for the cold-stabilization process -- a process through which white wine is cooled to a low 28 degree Fahrenheit and then heated back up to 55 degree Fahrenheit. Both technologies are to be installed on a single skid at the project location in Sonoma County, along with monitoring and verification equipment. Jackson Family Wines owns the bottling facility where the technologies are being tested.

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

The project focuses on full-scale technology demonstrations of two water and energy saving technologies for the wine industry. The water treatment and reuse system uses reverse osmosis to treat water to potable standards for barrel washing with an estimated water savings of 90 percent at the facility. This technology is in use in alternative markets, but not at wineries. The second technology is an innovative wine-to-wine heat exchanger for the cold-stabilization of the white wine that reutilizes the thermal potential of existing cooling and heating streams which reduces the amount of energy used for processing white wine. Cold stabilization process is one of the most energy intensive

processes in the wine industry and one that could significantly benefit from the simple wine-to-wine heat exchanger technology.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: Water and energy savings are expected to reduce energy bills, leading to lower operating costs for winemakers and owners of bottling plants. Treating and reusing barrel wash water results in additional energy savings by reducing electricity costs associated with pumping water from wells. Furthermore, the wine-to-wine heat exchanger technology for the cold-stabilization of wines offers significant electricity and natural gas savings. The estimated overall annual energy cost savings for this project is $54,418.

Environmental Benefits: This project is estimated to reduce the amount of fresh groundwater used for barrel washing by 90 percent annually. Reuse of the treated wastewater for barrel washing is expected to save 1.4 million gallons of fresh water annually. In addition, the wine-to-wine heat exchanger technology can result in energy savings and greenhouse gas emissions reduction. The annual greenhouse gas emissions reduction for the overall project is estimated to be 504,111 pounds of CO2e, based on electricity, natural gas, and water savings.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$157,088

EPIC Funds Encumbered:

$1,989,201

EPIC Funds Spent:

$1,460,207

Match Partner and Funding Split:

Jackson Family Wines: $404,625 (16.9 %)

Match Funding:

$404,625

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

27 out of 35 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Name: Vibratory Shear Enhanced Processing (VSEP). **Type:** Project-relevant pre-existing IP - Technology, Design, Drawing. The proprietary technology was fully developed and patented by the owner, New Logic Research Inc., prior to the start of this Agreement. Name and date of Copyright and Patent to be provided.

Update:

Three quarterly measurement and verification (M&V) reports were submitted and the fourth (final) report is being finalized. The third quarterly M&V report identified the to-date operation and performance of the two water and energy saving technologies deployed and demonstrated at the Jackson Family Wines facility. Each technology presented unique opportunities for savings. The water treatment and reuse system (VSEP) yielded about 68% water recovery from the raw influent. Moving forward, formal optimization procedures may result in even higher percent recovery of water. The second technology, the wine-to-wine heat exchanger system, was able to reduce energy costs by 88-98% and has shown that it is capable of operating within the required performance specifications.

Project Name: EPC-15-053 - Customer-Centric Approach to Scaling IDSM Retrofits

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

The California retrofit goal is to reduce 50% of existing buildings' energy use by 2030. Disadvantaged, low-income, multifamily communities are one of the most important retrofit targets, yet have no cost-effective pathways to achieve these goals. Multifamily housing is a very difficult market segment to address due to split incentives as retrofits are the responsibility of a property owner but he/she does not pay the energy bill. Limited technical and financial knowledge for owners also plays a role.

Project Description:

This project develops and demonstrates an approach to scale residential retrofits for disadvantaged communities that will focus on customer-centric solutions. This project develops and demonstrates an innovative approach, focusing on energy efficient integrated demand side management (IDSM) retrofit packages that are non-intrusive to occupants and have the potential of reducing energy use by 30 to 40 percent.

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

The project provides new data, analysis, and designs for cost-effective integrated demand side management retrofits that addresses some of the infrastructure challenges with existing multifamily buildings. The recipient has identified advanced technologies associated with HVAC and water heating that hope to overcome the infrastructure challenges, along with other innovations including smart thermostats, plug load controls, and LED lighting. The project results and monitoring and verification data will determine whether these portfolio of projects can achieve the goal of 30-40% reduction in energy use while minimizing tenant disruptions.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: These integrated retrofits could reduce energy use by 30 to 40% in multifamily buildings. The project could result in significant savings in energy and operating costs to building owners and residents.

Environmental Benefits: This project has the potential to reduce air and greenhouse gas emissions due to the reduction or elimination of natural gas use for space heating, water heating and cooking. Also, the projects will include the use of solar PV to meet a portion of the electrical needs of the multifamily buildings.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,382,796

EPIC Funds Encumbered:

$3,894,721

EPIC Funds Spent:

$2,386,045

Match Partner and Funding Split:

BIRA Energy: $25,000 (0.5 %)

Southern California Edison: $312,572 (6.7 %)

LINC Housing Corporation: $461,987 (9.8 %)

Match Funding:

$799,559

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 5: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project has two demonstration sites. In Ontario: The research team has completed obtained 12+ months of post-retrofit data. The preliminary results show reduced electricity use after installation of high efficiency heat pumps and insulated roofs. In Fresno: Site installation is delayed due to the lack of technologies that are able to support the existing electrical infrastructure. The research team has identified a 110V HVAC heat pump from Europe and a community heat pump watering system. The heat pump water heaters will consist of one large tank and heat pump per building that will service existing pipes and tanks of the residential units.

Project Name: EPC-15-054 - Complete and Low Cost Retail Automated Transactive Energy System (RATES)

Recipient/Contractor: Universal Devices, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

Existing Demand Response programs, tariffs and wholesale markets in California are focused primarily on reliability and peak load reduction. The end-use loads enrolled in these programs tend to have high opportunity costs so participation in these programs is low. Participation logistics - including metering, telemetry, baseline estimation, verification and settlement - still serve as a barrier to wider participation. Substantial research and technology development over the past decade have pointed toward a vast untapped potential for balancing electricity supply and demand in near-real time through better management of customer loads and distributed energy assets.

Project Description:

This project will develop and pilot-test a standards-based Retail Automated Transactive Energy System (RATES), and behind the meter energy management solution. The purpose is to minimize the cost and complexity of customer participation in energy efficiency programs, maximize the potential of small loads to improve system load factor, shave peaks, integrate renewable generation, and provide low opportunity-cost resources to the grid. This project will work with Southern California Edison to facilitate customer participation and expand Demand Response Participation in the area served the Moorpark substation.

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

This project developed an energy management automation platform that allows customers to participate in Demand Response (DR) markets by providing them the means to pre-program their preferred operational settings for end-use devices such as thermostats, pool pumps, and battery storage under variable pricing conditions. The technology applied those preferences to automating real-time response to energy market and rate variations using off-the-shelf equipment and a two-way subscription tariff design that allows customers to consume when prices are low and conserve when prices are high, without the need for complicated measurement, verification, and baselines. SCE staff believes that the

approach has value and has provided additional funding to continue technology development and pilot testing after the EPIC project term ended.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1c, 1e, 1f, 1g, 1h, 3f, 4a

Lower Costs: The primary goal of the project was to reduce the cost of customer participation in energy efficiency and automated demand response programs. Ratepayer savings are anticipated to come from reducing procurement and grid capacity expansion costs as well as reducing carbon emissions and helping integrate renewables. Customer savings come from facilitating individual customers participation in real-time energy markets and/or demand response programs through an automated platform that constantly monitors electricity prices and automatically schedules end-use device operation to minimize bills while meeting customer needs and preferences.

Greater Reliability: Greater flexibility of demand increases reliability by reducing or increasing load in response to system conditions. The transactive energy platform developed by this project provides a way for large numbers of small customers to manage their demand in response to real-time energy prices or other demand response signals automatically and, from the customer perspective, invisibly. The success of this platform depends on the will of grid operators and utilities to translate grid conditions into a real-time signal to which demand can respond.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$3,187,370

EPIC Funds Spent:

$3,185,294

Match Partner and Funding Split:

TeMix, Inc: $919,325 (21.5 %)

TBD Electrical Contractor: $7,000 (0.2 %)

TBD - Controls: $1,150 (0.0 %)

Universal Devices, Inc.: $160,235 (3.7 %)

Match Funding:

$1,087,710

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 21 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has been completed. The level of engagement by utilities and other partners is expanding the project impacts beyond what was initially anticipated in the agreement. SCE provided additional funding to support expansion of the research in the Moorpark substation area (a disadvantaged community also at risk for reliability issues). In addition, Google has been working with the team to evaluate its Alexa technology as a platform for hosting the transactive client. Post-EPIC project demonstrations are underway and SCE has provided funding to expand the number of test sites and include battery storage in the pilot, as well as facilitating expanded participation in CAISO markets.

Project Name: EPC-15-057 - Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings

Recipient/Contractor: The Regents of the University of California on behalf of the California Institute for Energy and Environment

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

The services demanded by commercial building customers--heating, cooling, ventilation, lighting, and so on--require significant energy and contribute to peak energy demand. Large commercial customers typically have a building management systems (BMS) that can be used to control HVAC and lighting in order to respond to price signals. However, small commercial customers typically do not have such capability, and thus cannot easily participate in demand response (DR). There are few DR solutions that address the complexity and heterogeneity for the diverse and varying needs of all commercial customers.

Project Description:

The purpose of this project is to improve small and large commercial customer participation in demand response programs by providing a cost-effective energy management system that allows a wide range of service offerings as well as effective and automated price-based management. The project will develop automated control systems capable of responding to dynamic pricing and program designs. Design improvements include: 1) receive price signals and evaluate energy demand; 2) enable heterogeneous customers to adapt to DR with individual preferences; 3) track, evaluate and control multiple devices; 4) interoperate with various building systems; 5) retain the electrical usage history of connected devices; 6) provide pricing based load management algorithms; 7) coordinate to maintain load diversity; 8) provide security; and 9) provide value by allowing customers to minimize the opportunity costs of participating by selecting the least-impactful load management strategy.

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

This project developed an open source software solution that is combined with an open architecture enabling platform. The eXtensible Building Operating System (XBOS/DR) can interface with multiple hardware devices from different vendors as well as include software applications from various vendors. With its ability to create a virtual building

management system for small commercial buildings by networking thermostats and other controllers, XBOS/DR can provide large and small commercial customers with a variety of choices for DR capability. The open architecture can foster technical innovation by third-party vendors and other manufacturers in providing energy services.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1c, 1e, 1g, 1h, 4a

Lower Costs: The recipient estimates that the XBOS software has the potential to reduce energy costs for ratepayers by $260 million per year in 2024 - due to lower demand charges, increased electric grid energy efficiency, reduced energy end-use from persistent efficiency in parallel with DR, and lower generation costs.

Greater Reliability: The XBOS software has the potential to reduce or shift 450 MW of peak electric demand by 2024. This is a 150% increase beyond the current 293 MW of DR from a combination of nonevent-based programs, critical peak pricing, and peak-time rebates estimated by the California Energy Demand 2016-2026 Revised Forecast.

Environmental Benefits: The project has the potential to reduce 930,000 metric tons of CO2e and 130 metric tons of NOx emissions per year avoided in 2024 from: increased electric grid energy efficiency, increased end-use energy efficiency in parallel with demand-management, and an increased fraction of intermittent operationally GHG-free renewable electricity generation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,373,762

EPIC Funds Encumbered:

$4,000,000

EPIC Funds Spent:

$2,544,449

Match Partner and Funding Split:

Siemens Corporation, Corporate Technology: $400,000 (9.0 %)

Quantum Energy Services & Technologies, Inc. (DBA: QuEST): $24,000 (0.5 %)

Match Funding:

$424,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 21 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

There are several open source IP being used, including: the eXtensible Building Operating System, the Monitoring and Actuation Profile, the Building Operating System Services Wide Area Verified Exchange, the Berkeley Tree Database, Giles, and OpenBAS.

Other IP include: Semantic Integration of Wearable Sensors into Professional Healthcare, EnergyOP, and OWL implementation of SPC201.

Update:

The project is complete. The researchers successfully developed a cost-effective energy management system that allowed a wide range of service offerings as well as effective and automated price-based management. This is achieved by developing automated control systems capable of responding to dynamic pricing and program designs. Most buildings that installed networked thermostats showed modest savings of 7-9%. DR event testing across 13 buildings resulted in an average of daily savings of $5.53, and 21 kWh in energy savings, with as high as $31.68 and122.01 kWh. The near-term target market is research groups who need data for analytics. The mid-term target market are utility program designers and startup companies who need building and system data. The platform will continue to be used in additional research projects funded by NYSERDA and DOE.

Project Name: EPC-15-059 - UniGen Smart System for Renewable Integration

Recipient/Contractor: Onset, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/24/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

The electric grid was designed on the presumption of a predictable and slow-moving load and the generation scheduled to serve it. Grid operators rely on an Energy Management Systems to identify deviations from the scheduled generation. After a deviation, operators make adjustments manually and wait for the adjustment to take effect (approximately 10 to 30 minutes). During this time, disruption caused by the volatility of wind and solar most likely changes the operations of the grid. This variability results in increased threats to electricity reliability and costs to California ratepayers and may limit the amount of renewable electricity generation that can be accepted by grid operations.

Project Description:

This project developed the UniGen Smart Software System, a control software capable of reducing the volatility of energy output from a combination of variable energy resources (VER). VER generation often deviates from forecasts and schedules because of variations in weather. This can be alleviated by a fast-acting control system that automatically compensates for deviations from projected generation using a dedicated mix of energy resources (e.g., a photovoltaic system and an energy storage system). Onset's UniGen control system couples these resources with a primary power plant using proprietary algorithms in a software application in real time so that the combined output corresponds to the committed output. Any deviation is solved at the project or distributed level, making it easier for the California Independent System Operator (CAISO) to manage grid performance

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

This project developed a software control system that can help integrate large amounts of VERs envisioned by California's energy policy (i.e., 33 percent by 2020 and 60 percent by 2030) along with current generation to create a more stable system. This software control system simplifies the CAISO's energy balancing efforts.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1a, 1h, 2a, 3a, 5a

Lower Costs: The cost of using UniGen to couple a VER with a dedicated power plant can be substantial, up to $200 million per year for every 1000 MW of VERs. Results indicate that when using UniGen, market participants have financial incentives to schedule VERs, thereby enhancing the integration of a larger amount of renewables. The UniGen Smart System has the potential to save California ratepayers an estimated $36M a year by enabling VER to generate more energy (avoiding curtailment) and reducing the cost of maintaining the Day-Ahead Schedule.

Greater Reliability: The software could help the California ISO maintain grid reliability and avoid non-compliance with NERC standards. If the controllable generation is insufficient or not timely during the afternoon peak, there is the threat that system frequency will fall below levels required by NERC. This system could assist the California ISO in real-time balancing, which should reduce the likelihood of over or under supply.

Environmental Benefits: The software could help California achieve aggressive climate change goals by accelerating the penetration of higher levels of renewable energy sources. This project would reduce GHG emissions associated with 2 GW of Combined Cycle plants running at minimum load.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$638,993

EPIC Funds Spent:

$630,853

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

23 out of 29 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in March 2019. The final report is in the publication process. This project conducted a feasibility study for the UniGen Renewable Integration platform, which allows VERs to be scheduled in the Day Ahead Market (DAM). Using the DAM, in conjunction with UniGen and VERs, allows for greater penetration of renewables and a pathway for California to meet the 60% RPS. Onset, now known as Unigen Resources, entered into a partnership with Marin Clean Energy to undertake a pilot project. This project represents the first step toward commercialization of the Unigen Smart System.

Project Name: EPC-15-060 - Optimizing Solar Facility Configuration Effects on Habitat, Managed Plants, and Essential Species Interactions

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 7/21/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Habitat variation and changes to species interactions within and adjacent to energy installations may regulate impacts to species of concern, including rare and invasive species. Typical management planning for both rare and invasive species takes a single-species approach, and may overlook how species' responses change over the variation in micro-environmental conditions within energy facilities and mitigation areas. In addition, altered species-interactions may drive long-term failure or success of species in landscapes modified by renewable energy development and operation.

Project Description:

This research implemented field-based experiments to quantify how microhabitat conditions vary across solar energy facilities. It then examined how those variations in microhabitat affect rare plants, invasive plants, and sensitive insects. Researchers determined how habitat variation affects target plant species and their essential species interactions, including herbivory, predation, and pathogens. The results lead to a series of management recommendations for siting new renewable energy facilities and their operation.

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

This project provided methods to improve understanding of the environmental impacts of solar energy facilities caused by direct changes in microhabitat or by site preparation treatment. It also enhanced the ability to predict and overcome costly invasions of non-native plants. It is one of the few studies that has considered the effects on species interactions throughout the food web, rather than just the effects on a single species.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard Program: R.18-07-003

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

Lower Costs: This research may reduce costs in the siting and deployment of renewable energy by assessing the benefits or ecological costs of different facility configurations, providing guidance for the design of future solar facilities and the cost-effective management of native and invasive species in existing facilities.

Environmental Benefits: This research may benefit ratepayers by providing effective, efficient strategies for the management of state and federally listed species within and adjacent to energy facilities. The study will also inform facility managers about controlling invasive species in solar energy facilities.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$99,801

EPIC Funds Encumbered:

$597,865

EPIC Funds Spent:

$504,773

Match Partner and Funding Split:

The Regents of the University of California, Santa Cruz: $54,940 (7.8 %)

Regents of University of California, Davis: $48,357 (6.9 %)

Match Funding:

$103,297

Leverage Contributors:

Bureau of Land Management: $150,000

Leveraged Funds:

$150,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 6: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project was completed in 2019. The photovoltaic-annual plant experiment studied the effects of solar panels on microhabitat from the effects of shade and enhanced runoff and how those changes affect the growth, survival, and reproductive success of native and invasive species. The results indicate that solar energy development in the Mojave Desert may have adverse impacts on some desert plants and that the level of impact may be regulated, to some extent, by informed site preparation and management practices. The concentrating solar-milkweed experiment found that plant-conservation islands, known as halos, are effective for Mojave milkweed conservation and maintenance of Mojave milkweed-queen butterfly trophic interactions, whereas blading sites was not. Several journal papers are in preparation or review.

Project Name: EPC-15-062 - Robust, Low-Cost, Real-Time, NOx Sensor for Optimization of Dispatchable Distributed Generation Systems

Recipient/Contractor: The Regents of the University of California, Irvine

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/7/2016 to 4/18/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Low emission distributed generation technologies, such as microturbines and reciprocating engines, can improve onsite resiliency and provide supplemental supply for peak demand. Deploying clean, efficient, distributed generation systems directly addresses goals stated in AB 32, SB 350, and the Clean Energy Jobs Plan. While reducing greenhouse gases and improving efficiency are vital, maintaining strict air emission standards is also important. Distributed generation systems often suffer performance degradation over time once deployed. This may lead to increased emissions of air pollutants, such as NOx. As a result, there is a need for a low cost approach to monitor emissions performance.

Project Description:

The project tested several recently developed sensors with the capability to detect low NOx levels generated by dispatchable generation systems, such as internal combustion engines and microturbines. The proposed solution offers a cost effective means to monitor the real time emissions of the system and information that can be used to optimize system performance and maintain low emissions.

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

The NOx sensor is based on ceramic solid-state electrochemical sensor technology, similar to an automotive oxygen sensor. Solid state NOx sensors have been developed for direct in-situ measurement of exhaust to meet stringent on-board diagnostic requirements for self-diagnosis and reporting, including required sensitivities down to parts-per-million. The NOx sensor combines existing commercial NOx sensors with newly developed electronics for use in applications such as dispatchable distributed generation (e.g., microturbines). Unlike other NOx sensors, the sensor is a simple solid state device, with a single cell and no internal diffusion chambers (electrodes directly in the flow). This gives it faster responsiveness, and makes it both more robust and easier to manufacture.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Combined heat and power: D.10-12-035., R.08-06-024. (closed)

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

Lower Costs: The cost to add the sensor system to a given engine is estimated to be about $2,000, well below a typical current monitoring system priced above $10,000. The cost should come down further as the number of units increases.

Environmental Benefits: For the estimated current 50 MW fleet of microturbine generators in California, a 10% reduction in NOx for each distributed generation device operating at partial capacity will would reduce NOx emission by 30 tons each year. Because the control algorithm concept demonstrated and tested relied on changing turbine electrical performance, it is not clear how much of those environmental benefits can be realistically achieved without compromising turbine functionality as a source of dispatchable synchronous current. Future research should evaluate optimization of these advanced systems for economic dispatch and stability criteria as well.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$53,531

EPIC Funds Encumbered:

$200,000

EPIC Funds Spent:

$199,270

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 11: Ranked # 8

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is completed. The results show that the two automotive solid state NOx sensors selected proved durable enough to perform reliably for the 6-month evaluation. The research team developed an engine control system integrated with information from the solid state NOx sensor and successfully demonstrated the ability to actively reduce NOx emissions at part load by 10%. The results show that solid state sensors represent an inexpensive and viable approach for monitoring emissions from distributed gas generation systems. This technology could potentially be implemented in California Air Resource Board's certification process for small distributed gas generators as an alternative to the existing Continuous Emission Monitoring System.

Project Name: EPC-15-070 - Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System

Recipient/Contractor: Altostratus, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/7/2016 to 5/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Probabilistic decadal, seasonal, and short-term climate forecasts for the electric system are typically produced with climate models at relatively coarse resolutions (e.g., 3-10 km) and using observations from sparse networks of meteorological stations. These forecasts and observational analyses do not explicitly take into account the fine-scale intra-urban variations in climate. Intra-urban variations in temperature average 1-4 degrees C in California and can be as large as 10 degrees C. It is important to explicitly account for them in the seasonal, decadal, and short-term forecasts of the electric system that serve as a basis for planning by the Energy Commission and the utilities.

Project Description:

This project developed a methodology for creating probabilistic fine-scale temperature zones in California focusing, initially, on summer conditions in the Los Angeles region and the greater San Francisco Bay Area. This was done for both current and future climates and land-use conditions. The project also reduced forecasting errors and uncertainties by improving the performance of the urban Weather Research and Forecasting model (uWRF). Observational weather data from a dense network of mesonet stations were used in model performance evaluation and validation.

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

This project added fine-resolution, intra-urban climate detail to coarse-scale, regional-level probabilistic or deterministic forecasting, thus allowing for more accurate, area-specific characterizations and forecasts for the electricity system and better apportionment of electricity generation.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Applicable Metrics: CPUC Metrics- 1e

Greater Reliability: This project reduced the mean urban temperature forecasting error significantly. Conservatively assuming an average improvement of 0.5 degrees C in forecasting peak temperatures in Californian cities within the CAISO service territory, this translates into a more accurate allocation of ~ 500 MW in generating capacity, which is equivalent to the output from 1 to 3 large power plants. The study suggests that the improvements in allocation can actually be twice as large as this. Information generated in this project can assist in planning for and reducing the vulnerability of the electric grid to changes in climate both in short and long terms, as well as to future changes in land use.

Environmental Benefits: Improved forecasts can result in lowered emissions of GHG and air pollutants, as it reduces the need to procure short-term, flexible generation that is typically from fossil fuel resources. The methodology developed in this project can be used to develop fine-scale weather data, i.e., weather files, for energy modeling.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$14,035

EPIC Funds Encumbered:

$193,326

EPIC Funds Spent:

$193,075

Match Partner and Funding Split:

Altostratus, Inc.: $5,000 (2.5 %)

Match Funding:

$5,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 11: Ranked # 6

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has been completed. The results show mean urban temperature forecasting error was reduced by up to 1.8 degrees C in the San Francisco Bay Area and up to 0.8 degrees C in the Los Angeles region. The magnitudes of intra-urban temperature variations, including effects of heat islands, are similar to or larger than those of the predicted localized impacts of climate change. Intra-urban variability in temperature (within each Energy Commission building climate zone) was found to be larger than the inter-zone differences, sometimes by several times. Therefore, intra-urban variability is important to account for in planning for electric demand and in building energy modeling.

Project Name: EPC-15-072 - New Chemical Compounds for Cost-Effective Carbon Capture

Recipient/Contractor: The Regents of the University of California, Davis Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Although recent regulations will greatly reduce greenhouse gas emissions, fossil fuels will continue to be important to California energy infrastructure for decades. Carbon capture can reduce the greenhouse gas (GHG) emissions from electricity producing facilities that rely on combustion of fossil fuels (coal, natural gas, and oil). Carbon dioxide (CO2) capture and sequestration (CCS) could play an important role in reducing greenhouse gas emissions, while enabling low-carbon electricity generation from power plants. The current CO2 capturing compounds make the CO2 removal process very costly and produce additional waste.

Project Description:

This project uses computational chemistry to support the discovery and characterization of new chemical compounds that can safely and economically capture carbon dioxide (CO2) from the stacks of power plants and other large emitters.

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

This project uses innovative ab initio quantum mechanical and molecular dynamics simulations to design and characterize carbon capturing compounds, mimicking processes previously discovered in plants in arid areas. The organic phosphoenolpyruvate (PEP) compounds in these plants store and release CO2 in a similar manner as the currently used inorganic amines. Organic molecules can be modified in a way that adjusts their reaction enthalpy, solubility, viscosity, and reaction rate to be an inexpensive, non-toxic substitute for amines in carbon capture.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

Applicable Metrics: CPUC Metrics- 2a, 4a

Lower Costs: Improved solubility of potential carbon capturing molecules in water instead of expensive organic solvents would result in significant cost savings if applied in large-scale carbon capture processes.

Environmental Benefits: A path for a significant reduction of greenhouse gas emissions from fossil fuel burning energy systems could be developed based on successful project results.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$40,000

EPIC Funds Encumbered:

$200,000

EPIC Funds Spent:

$178,500

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 11: Ranked # 9

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-072 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team completed simulation and optimization of candidate carbon capturing molecules using molecular dynamics modeling tool, such as Aspen Plus. The data obtained from the calculations include information about solubility and viscosity of candidate molecules, as well as their ability to form bonds with CO2 molecules.

In late 2019 and 2020 UC Davis in collaboration with EPRI will model a carbon capture process in a typical electricity producing power plant for chosen candidate molecules. This exercise will provide information about the thermal energy needed by the cycle for stripping, electric energy needed by the cycle for pumping, and effectiveness of CO2 capturing processes. This modeling work will help elucidate the performance of novel carbon capturing molecules compared with commonly used amines.

Project Name: EPC-15-073 - Identifying Effective Demand Response Program Designs to Increase Residential Customer Participation

Recipient/Contractor: The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

As the state moves toward more distributed generation and intermittent renewable energy generation, there is a need for smaller resources to play larger roles in distribution and transmission grid management. The end-use loads enrolled in Existing Demand Response (DR) programs have high opportunity costs and participation is low. Some newly-developed market options, such as aggregation programs, could enable large numbers of small loads across multiple customers to participate in wholesale markets. However, participation logistics, including metering, verification and settlement, are barriers to wider participation.

Project Description:

This project tested the effectiveness of innovative designs for demand response programs for residential customers using a behind-the-meter customer engagement platform developed by OhmConnect. This innovative demand response strategy integrates a recent approach that energy researchers have shown to be effective in reducing customer consumption. This strategy includes providing households with a) tailored energy-analytic feedback, b) aggregated versus single-period incentive information, c) non-financial environmental health benefit frames and d) social comparisons. An additional strategy included exploring the effects of timing of the delivered demand response information on the magnitude of household participation and response.

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

This project tested the effectiveness of innovative design strategies for residential demand response providers and analyzed different segments of the residential population including various socioeconomic groups and residential customers with photovoltaics and electric vehicles to see what incentives, messages and energy use information motivated reliable participation in utility demand response programs. This information expanded

knowledge in this area so that utility companies and regulators can build new and modify existing demand response programs to increase effectiveness. Accurate and reliable forecasts of participation in these programs will enable better utilization of existing generation resources and deferral of system capacity upgrades thereby lowering consumer electricity costs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1h

Lower Costs: This project could lower ratepayer costs through better design demand response (DR) programs which will enable greater utilization of existing electricity generation resources by increasing residential customers participation in DR. System-wide this could reduce the need for high cost peaker plants during extreme climate events. Participants in the DR programs could be rewarded with incentives that would result in lower energy bills.

Greater Reliability: Greater electric system reliability could be achieved through increased residential demand response program participation and having this contribute towards greater grid optimization, flexibility and lowering imbalances on the grid.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$203,115

EPIC Funds Encumbered:

$2,007,875

EPIC Funds Spent:

$1,625,539

Match Partner and Funding Split:

Chai Energy: $288,853 (11.2 %)

University of California Los Angeles: $273,780 (10.7 %)

Match Funding:

$562,633

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 21 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is complete. The project evaluated the effectiveness of two innovative designs for residential demand response. One provided feedback information on energy use and advanced dynamic thermostat automation, the other engaged customer using social media to reduce loads when asked. Both evaluations confirmed that customers will manage their energy consumption by conserving or shifting loads if they are convinced there is a need and if their ability to participate is simplified. While the information/thermostat experiment has now ended; the participants in the social media-based program continue participating through the third-party aggregator, who continues to expand their client base and provide DR services through ISO markets.

Project Name: EPC-15-074 - Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems

Recipient/Contractor: Center for Sustainable Energy

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/18/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

The State of California has established aggressive goals for incorporating behind-the-meter, customer-sited distributed energy resources (DERs) into the California wholesale energy markets, managed by the California Independent System Operator (California ISO). However, with only limited testing performed to date, the ability of DERs to simultaneously and cost-effectively meet onsite customer electrical needs while providing energy services into the California ISO market is largely unproven.

Project Description:

This project develops co-optimization strategies for distributed energy resources (DERs). The purpose is to maximize customer and system value under existing CPUC-approved retail and California Independent System Operator (California ISO) wholesale tariff structures, future market structures and pricing, and the transactive energy pricing signals developed under agreement EPC-15-054. The project tests and configures two DER portfolios: a) one consisting of large retail customers and schools using battery energy storage, solar photovoltaics, and integrated load management, and b) the other consisting of hotels using passive thermal energy storage, and energy efficiency. Both will be included as part of an integrated load management strategy capable of responding to price and reliability signals. The project team is also developing operational strategies for wholesale integration subject to the identified retail and wholesale tariffs and other operational constraints.

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

The project is developing and testing strategies that customers, demand response (DR) aggregators, scheduling coordinators, and policy makers can implement to provide demand response that both meets grid needs and is acceptable to customers. The project will provide comprehensive recommendations on how to overcome technical, institutional and regulatory barriers to facilitating DER participation in supply-side markets.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Energy storage: R.15-03-011 (closed) Smart grid: R.08-12-009 (closed) Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1f, 1g, 1h, 3e, 3f

Lower Costs: This project has the potential to lower energy costs for individual customers, as well as system costs for all ratepayers California ISO market participants. On the distribution circuit, demonstrated demand management capabilities can help defer cost of expensive capacity upgrade investments such as transformer or line upgrades.

Greater Reliability: As the penetration of intermittent resources increases in California, energy balancing requirements increase as well. Behind-the-meter demand response and storage on the distribution system can increase distribution system reliability issues through services such as local overload relief, power quality and ramp-rate mitigation on circuits with high penetration of photovoltaics.

Increase Safety: By deploying, testing, and validating system integration, metering, and telemetry, the project will contribute to the safe operation of DER systems in customer-sited locations while maximizing value for these systems to both customers and wholesale market activities.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$746,794

EPIC Funds Encumbered:

$3,960,805

EPIC Funds Spent:

$2,571,688

Match Partner and Funding Split:

Solar City Corporation: $1,449,262 (24.4 %)

DNV GL: $2,000 (0.0 %)

Conectric Networks, LLC: $530,000 (8.9 %)

Match Funding:

$1,981,262

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 21 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-074 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Subcontractor Conectric, LLC. will employ patented and unregistered IP in the operation of control systems being used to evaluate different load management strategies and customer impacts in this project.

Update:

The project is on schedule. The prime participated in a meeting and walk-through with Hilton Hotel management, the engineering and market participation coordination subcontractor to confirm ongoing participation. The ISO market participation analysis shows the potential for $15,000 in annual wholesale market participation as a Proxy Demand Resource. Ongoing bill savings of about $47,000 is resulting from operations optimization using the sensor/control network. Coordination with the ISO to obtain all required permission for telemetry testing for Ancillary Services market participation is ongoing. The PV/battery/load control project with 8 schools in Chino Hills continues operating; M&V data being collected.

Project Name: EPC-15-075 - Customer-centric Demand Management using Load Aggregation and Data Analytics

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/18/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

Load management in buildings has been lagging for decades due to lack of technology that can reliably provide reductions while gaining customer acceptance. As the State moves toward high penetration of customer-sited renewables that increase the management challenges for grid operators, it is imperative that load management for large numbers of small customers become mainstream. The technologies to manage loads are rapidly being developed and deployed, but relying on privately-developed proprietary solutions carries the risk of inconsistent performance as well as customer confusion and dissatisfaction.

Project Description:

This project will demonstrate how a large number of small loads, each impacted by and tuned to individual customer preferences can provide load management for both utilities and the ISO in California. Recipient will work with an extensive spectrum of leading product providers covering all major distributed energy resources, such as Nest (thermostats), ThinkEco (plug loads), Honda, BMW (auto), EGuana (smart Inverter) and Ice Energy (Thermal Storage). A variety of price signals will be tested, including the transactive signal developed by EPRI, Time-of-use, Critical Peak Pricing and Demand response rates.

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

This project is using low cost off-the-shelf technologies to develop a platform that can manage customer end-use devices according to their preferences, minimize their energy costs, and adapt to evolving tariff structures. By making the task of automating multiple end-use devices easier, less costly, and less of an imposition on customers, the project has the potential to increase demand response participation, with consequent benefits to the electric grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Self-Generation Incentive Program: R.12-11-005 Energy storage: R.15-03-011 (closed) Smart grid: R.08-12-009 (closed) Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Long-Term Procurement Proceeding (LTPP): R.13-12-010 (closed) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1f, 1g, 1h, 5c

Lower Costs: Benefits include statewide residential electricity savings of approximately 1040 GWh per year and small commercial savings of 53 GWh per year for a total of 1093 GWh per year, which translates to estimated statewide CO2e reductions of 397,631 metric tons per year. The total annual bill reduction is approximately $8.21M for commercial facilities and $185M for residential buildings.

Greater Reliability: The project has the potential to increase adoption of demand response programs from the current 15 percent to as much as 60 percent. Managing air-conditioning loads, plug loads, and electric vehicles could provide up to 12 GW of capacity that could be shifted to maximize utilization of renewable resources, provide ramping and other ancillary services, and contribute to greater grid flexibility.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,163,894

EPIC Funds Encumbered:

$3,998,587

EPIC Funds Spent:

$2,150,085

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $979,860 (18.6 %)

InTech Energy, Inc.: $280,452 (5.3 %)

Pedagogy World, Inc.: $10,000 (0.2 %)

Match Funding:

$1,270,312

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 21 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

"Energy360 Power Monitoring, Analytics & Controls" software is pre-existing intellectual property trademarked by InTech Energy.

The Chai Energy Logo is trademarked project-relevant pre-existing intellectual property.

The Olivine DER Platform and the EPRI Smart Thermostat Collaborative Data are project-relevant, unregistered pre-existing intellectual property.

Update:

The project is on track to complete in March 2020. The recipient is working with their key development partners to leverage the demand response scheduling interface with the CAISO market. Work is ongoing with project partners to fine tune the platform for data consumption and orchestration of the model commissioning is ongoing in homes located in Clovis and San Diego. In addition, the recipient continues to make progress on development of the energy information database and customer user interface requirements and testing and refining the messaging across all platforms. Next steps involve technology transfer activities including the development of a "lessons learned" white paper on the comparison of low-cost behind-the-meter monitoring with AMI data.

Project Name: EPC-15-078 - Risk Modeling and Cognitive Science Characterization of Barriers to Climate Change Adaptation in California Electricity Sector

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/30/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Adaptation to climate change is critical to ensure a robust electricity system for California. However, little is known regarding system-wide effectiveness of current electricity sector approaches to managing climate change-related risks. Similarly, little is known regarding barriers faced by electricity sector stakeholders' implementation of adaptation measures. This research develops a framework for systematically identifying barriers to climate adaptation and develops a metric to evaluate the performance of California's electricity sector in terms of adaptation to climate change.

Project Description:

Researchers developed a framework for assessing climate change risk and adaptation practices in the electricity sector, identifying perceived barriers to execution of resilience strategies, and delineating practices that are currently being implemented in the electricity sector. These activities form a basis for developing a dynamic model for long-term resilience planning that can identify optimal strategies to manage climate risks. The analysis also considers how independently initiated adaptation efforts perform relative to a system-wide strategy, with a focus on electricity sector vulnerabilities.

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

Researchers developed methods to account for risks, plan for resulting adaptation, and account for the barriers to adaptation. The results of research are intended to improve on the framing of climate-related policies under uncertainty and to examine all aspects of the adaptation planning process: key decision-makers, the stages of decision processes, and the institutional contexts where the decision-makers develop the decision processes. The results can inform technology choice investment and deployment to the extent that those choices are made with consideration of climate risks.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 (closed) Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Long-Term Procurement Proceeding (LTPP): R.13-12-010 (closed)

Applicable Metrics: CPUC Metrics- 1e, 2a, 3e, 3h

Environmental Benefits: This research benefits California rate-payers by identifying operational or informational barriers to adopting climate change adaptation plans and for proposing a framework to improve data collection and communications in the face of uncertainty from climate change.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$48,887

EPIC Funds Encumbered:

$350,000

EPIC Funds Spent:

$177,177

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 8: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-078 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project concluded in March 2019 and an initial project report was completed. A final report has not yet been provided despite multiple attempts to contact UC Berkeley's project manager. CEC is exploring options to resolve this issue.

Project Name: EPC-15-079 - Advanced Renewable Energy Storage and Recycled Water Project

Recipient/Contractor: Victor Valley Wastewater Reclamation Authority (VVWRA)

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/13/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Several California wastewater treatment plants have on-site power generation systems fueled by biogas. However, many of these systems are unable to respond to variable onsite electrical loads and this can result in tripping off a facility's wastewater treatment equipment. This results in shut downs of the onsite power generation system resulting in increased power costs and reliance on grid power and a corresponding reduced ability to produce recycled water. An effective power control system is needed to demonstrate that it can reliably collect and store excess renewable electricity generated on site and reduce the cost and increase the availability of producing recycled water.

Project Description:

The Victor Valley Wastewater Reclamation Authority (VVWRA), in partnership with Primus Power, University of California Riverside (UCR), and Anaergia, is demonstrating an advanced, pre-commercial flow battery storage and control system at VVWRA's existing Regional Wastewater Treatment Plant, located in a disadvantaged community outside of Victorville. The project deploys Primus Power's ENERGYPOD flow battery system in a 240 kW/1,200 kWh configuration, managed by a UCR-designed controller system that is optimized specifically for management, generation and storage of renewable energy power. The project hopes to alleviate rapid fluctuations in the wastewater treatment plant's power demand that causes disruption of the disinfection system used to treat recycled water to California standards, resulting in the disposal of approximately 2.5 million gallons of water annually.

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

The project demonstrates an advanced battery storage and control system coupled with on-site renewable energy generation and its ability to control rapid changes in on site power demands. If successful, this project could reduce grid power demand and reduce energy costs to wastewater treatment plants and alleviate disruptions in recycled water production due to high variability of on-site power loads which can cause partial

treatment shutdowns. The project results could be applicable to other wastewater treatment and industrial plants in California.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011

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

Lower Costs: This project uses a battery storage system combined with an advanced controller to enable the wastewater treatment plant to accommodate variable loads, increase onsite renewable power production, and substantially reduce its reliance on grid power. This project could reduce annual grid power demand by 4.2 million kWh or nearly $473,000 in cost savings to the treatment plant.

Economic Development: Stored power will be used to meet peak demand on site with 100% renewable energy, reducing grid power consumption by 4,213,416 kWh/yr.

Environmental Benefits: Equipment tripping off due to power fluctuations would be curtailed, enabling reuse and water savings of approximately 2.5 million gallons per year. This water could be used by the community in place of fresh water sources.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$220,423

EPIC Funds Encumbered:

$1,734,059

EPIC Funds Spent:

$1,235,654

Match Partner and Funding Split:

Victor Valley Wastewater Reclamation Authority (VVWRA): $773,014 (29.3 %)

Primus Power Corporation: $129,201 (4.9 %)

Match Funding:

$902,215

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

27 out of 35 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

December 2, 2019: Primus remotely started final SAT testing on Unit 2 and remotely investigated issues with Unit 1. December 4, 2019: Primus remotely ran a power charge and discharge cycle on Unit 2. The four out of five commissioning tests were completed that day. Regarding Unit 1, software and other faults had aborted commissioning tests. A site visit will be required to reinitiate commissioning activities on Unit 1. December 5, 2019: UCR was onsite for a meeting that communicated to VVWRA what data points need to be logged so that UCR can do some battery analysis with the two Pods on site. Term of the project ends 3/31/2020. New updated schedule received 11/5/2019.

Project Name: EPC-15-081 - Historical Insights for Electricity Transition Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity

Recipient/Contractor: Ghoulem Research

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/13/2016 to 6/28/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Planning and executing an energy transition of the scale and scope envisioned by California is new territory. New types of information, processes, tools, and frameworks are needed. Fortunately, highly granular consumption data, advances in computational power, and high-resolution climate projections are available to support sophisticated analysis of transition scenarios. California has been revising its approach to energy planning and demand forecasting. This presents an opportunity for adoption of flexible demand modeling tools that conceptualize energy demand as a dynamic socio-technical system, using data streams to illuminate technology trends, policy choices, and consumer response.

Project Description:

Analysis of quantitative and qualitative data sheds light on past energy technology transitions, planned and unplanned. The research team's analysis of these transition histories provided examples, principles and insights that can be used in future planning. Leveraging insights from historical technology transitions, the research team designed and tested a flexible, agent-based modeling platform ("SIMSAND") that enables researchers, utilities, and CEC demand modeling and forecasting staff to draw upon a wealth of empirical data as well as projected climate data to simulate dynamic residential demands for air conditioning. This model served as a proof of concept that might later be broadened to other energy uses and demand sectors. The model also illustrated the power of providing a platform that can draw on a variety of data streams available to illuminate energy consumption and potential transition trajectories, rather than representing key parameters as simple averages.

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

Results improve the state's ability to estimate timing of technology penetration and accrual of benefits, and costs of desirable residential sector technologies. These results

are key to improving the performance of efficiency measures outlined in AB 758 and the California Energy Code. They also support goals of CPUC's Energy Efficiency Strategic Plan, and inform updated estimates of timing and benefits as appropriate. Results portraying penetration and performance of key technologies (e.g., air conditioning) are expected to be of direct use in the scenario development and demand forecasts used in the Integrated Energy Policy Report.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Long-Term Procurement Proceeding (LTPP): R.13-12-010 (closed)

Applicable Metrics: CPUC Metrics- 5c

Environmental Benefits: The study developed a rigorous model that enables exploration of human dimensions that could hinder or enable the technologies that are essential in the transition to a deeply decarbonized electricity system.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$400,000

EPIC Funds Spent:

$393,999

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 11: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-081 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team convened in-depth discussions with members from the CEC's Demand Analysis Office, Supply Analysis Office, Building Standards Office, and Research Division as they worked to refine their flexible residential air conditioning demand forecast model ("SIMSAND"). SIMSAND, a prototype model to enable exploration of impacts of a number of human factors on residential air conditioning demand, was enhanced to have the flexibility to explore scenarios related to technology policy, adoption, and projected climate change. Through an agreement with Canadian smart thermostat manufacturer EcoBee, researchers obtained a very large data set of thermostat settings from Donate Your Data volunteer households. Researchers submitted a final report for publication and presented their work at the 2019 Behavior, Energy, and Climate Change Conference (BECC).

Project Name: EPC-15-082 - Low-Temperature Microplasma-Assisted Hydrogen Production from Biogas for Electricity Generation

Recipient/Contractor: The Regents of the University of California on behalf of the Merced Campus

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/1/2016 to 6/24/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Clean fuels are a critical component of solutions to climate change and local air quality. The development of cow-cost efficient hydrogen (H2) production from renewable sources such as biogas will be important if hydrogen is going to serve as a major source of clean fuel.

Project Description:

The purpose of this project is to demonstrate operation of a low-temperature microplasma reactor that will lead to an efficient, electricity-based technique to convert a mixture of carbon dioxide and methane into hydrogen for use in electricity generation. If successful, this technology could be adapted to use other gas inputs in the creation of hydrogen, such as products from the gasification of biomass.

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

Determination of optimal operating parameters for microplasma array reactors to achieve maximum efficiency is an important step in overcoming barriers for advancement of technology converting biogas to syngas. Successful lab-scale demonstration can serve as the proof of concept and lead to farther development of this technology, which has the potential to generate emissions-free hydrogen for use in hydrogen-fueled ZEVs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

Applicable Metrics: CPUC Metrics- 2a, 4a

Environmental Benefits: The production of syngas from a biogas using a low-temperature microplasma is more energy-efficient compared to a syngas production by gasification or pyrolysis and would allow for energy savings. Furthermore, syngas from

renewable resources produces very low emissions and reduces the carbon footprint from electricity generation.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$35,171

EPIC Funds Encumbered:

$200,000

EPIC Funds Spent:

$134,857

Match Partner and Funding Split:

The Regents of the University of California, Merced: $47,199 (19.1 %)

Match Funding:

$47,199

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

45 out of 45 bidders

Rank of Selected Applicant / Bidder:

Group 11: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in 2019. The project team designed and built a plasma reactor and tested its performance for a range of operating conditions. The following are the key findings:

1) The highest registered conversion rate of CH4 and CO2 to syngas (mixture of H2 and CO) was about 30% for the conditions tested in this project (30% of injected gas was converted to hydrogen).

2) The model developed specifically for this project predicts that an array of subsequently connected microplasma reactors working in tandem would improve the performance (conversion rate).

3) Compared to hydrogen production using electrolysis (splitting of water molecules into H2 and O2 by the means of electricity), the plasma reactor consumes twice as much power (125 W vs. 56 W to produce about 200 ml of H2 in a minute)

Project Name: EPC-15-083 - Empowering Proactive Consumers to Participate in Demand Response Programs

Recipient/Contractor: OhmConnect, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 5/18/2016 to 6/28/2019

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

The market for third-party demand response (DR) is constrained, severely limiting non-utility resources from contributing to the electricity grid. Although a bi-directional grid is now technically possible, neither prosumers (customers who both draw from and contribute to the grid) nor their devices can be integrated into the energy markets. A chicken and egg situation exists where policymakers and regulators will not open up the market for non-utility energy sources, citing a lack of customer interest, while customers remain unaware of how to contribute to the grid.

Project Description:

This project contains three elements to provide data for policymakers and businesses to explore this new market. First, this project determines prosumer (producer/consumer) interest in a third-party demand response market by testing user acquisition via direct and non-direct engagement strategies. Second, experimentation with behavioral and automated users allows analysis of user yield under a variety of conditions and extract a set of shadow curves that can inform how much energy load shifting can be expected under various price incentives. Finally, this project creates a novel solution for using residential telemetry to connect prosumers and their Internet of Things (IoT) devices to the market operators.

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

This project provides critical evidence that residential customers are willing to manage their electric loads for the purpose of meeting grid needs when presented with meaningful, actionable information and salient incentives. The approach makes use of multiple social media platforms for communication and has developed multiple virtual customer "experience" opportunities using those platforms that enhance participation and keep customers interested and involved. The project provides conclusive evidence that with the appropriate approach, residential customers can and will adapt their energy use to a grid that depends heavily on variable renewable generation. This evidence can be

used to help policymakers and regulators develop more effective direction for utility tariff and program design and program parameters for third party aggregator participation in demand response.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed) Customer Data Access Program: Applications A.12-03-002, 003, 004. Decisions D.11 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 California Solar Initiative: R.12-11-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1f, 1g, 1h, 3e

Lower Costs: This project has reduced (and continues to reduce, after project completion) electricity costs for participants and overall costs for ratepayers by providing an alternative to fossil-fueled electric generation for meeting temporary load peaks and providing carbon-free grid services during ramping conditions.

Greater Reliability: This project has reduced the complexity for customer load management to serve as a predictable and reliable grid asset, thereby increasing the pool of carbon-free grid resources, stabilizing the grid by more effectively coordinating demand and supply resources, and enabling grid services to be crowdsourced to balance variable renewable generation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$245,265

EPIC Funds Encumbered:

$3,995,028

EPIC Funds Spent:

$3,908,849

Match Partner and Funding Split:

Schneider Electric USA Inc.: $120,000 (2.0 %)

Honeywell, Inc.: $164,000 (2.8 %)

OhmConnect, Inc.: $1,593,378 (27.1 %)

Match Funding:

$1,877,378

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 21 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-083 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

OhmConnect has built a user experience when registering, engaging, and interacting with the OhmConnect product. This user experience will be modified in ways to incorporate this project's goals for a subset of users. Those modifications are not covered in this Intellectual Property. During this project, certain portions of this user experience will be exposed in various contexts to the CEC.

Update:

This project has been completed. Over 450,000 utility customers have signed up with OhmConnect, and about 35,000 of those participated in the experimental treatments conducted under the EPIC grant. About 15% of the enrolled customers live in Disadvantaged Communities. The recipient tested a number of different incentive structures--including a proxy-price "transactive" signal, including those provided by the customer's utility, the CAISO, and EPRI. Over the course of the project, the experimental subgroup saved 27.8 MWH over 1.3M #OhmHours (1-hr long participant events) for which they were paid a total of $668,000. CO2e emissions reductions were estimated at about 9 Metric Tonnes.

Project Name: EPC-15-084 - Total Charge Management: Advanced Charge Management for Renewable Integration

Recipient/Contractor: Bayerische Motoren Werke of North America, LLC

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S2: Develop New Technologies and Applications that Enable Cost-Beneficial Customer-side-of-the-Meter Energy Choices

Issue:

Smart charging is a means of managing charging within a particular charging or parking event, usually at work during the day or at home during the night. The future electricity grid will face new balancing needs that change throughout the day and night as utilities and grid operators attempt to align renewable generation with customer load. As the grid becomes more dynamic, optimizing vehicle charging will require moving charging from night to day, from hour to hour, or from one grid location to another. California's steadily increasing electric vehicle deployment with larger capacity batteries combined with the mandates for more renewables require more means for managed vehicle charging.

Project Description:

This project explores the benefits and opportunities of Total Charge Management, where electric vehicle charging is managed across multiple charging events to maximize vehicle load flexibility. The project tests how flexible electric vehicle load can be if managed across a driver's daily or weekly charge events. This flexibility utilizes several pricing mechanisms to estimate the benefits of the Total Charge Management approach. The research develops and evaluates advanced vehicle telematics for utilities and grid operators to align vehicle battery status, driver mobility needs, and grid conditions. Collaboration between the grid and the driver can yield a charging load profile that minimizes energy costs by aligning daily and weekly charging events to best meet grid needs.

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

This project helps the state advance the flexibility of electric vehicle charging as a flexible grid resource and vehicle charging cost savings to the driver. Optimal charging load patterns will be identified that can capture ratepayer and grid benefits using a variety of grid price signals. The project pioneers demand response and smart charging technology advancement of not only the temporal benefits of controlled charging, but also the

possible benefits that can be derived from being able to influence the location of charging.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1g

Lower Costs: The cost of Plug-in Electric Vehicle (PEV) ownership is estimated to fall by $500 per year through grid service payments and reduced electricity bills for PEV drivers through managed charging. In total, this would provide $4,000 in savings over the 8-year ownership life of a typical vehicle.

Greater Reliability: Total Charge Management would represent a resource of over 10,000 MWh per day. If 40 percent of that load could be flexibly managed, the following benefits would be realized every day: 3,000 MWh of solar-following load (enough to accommodate 4 million additional solar panels on the grid), and 1,200 MWh of wind-following nighttime load.

Environmental Benefits: Aligning vehicle charging with renewable energy generation has the potential to reduce carbon emissions associated with vehicle charging by as much as 660,000 metric tons per year, at a scale of 1.5 million vehicles.

Energy Security: Greater energy security comes from having more diverse distributed resources able to respond to grid needs. The Total Charge Management approach helps utilities and CAISO get more functionality out of electric vehicle load as a grid resource, which contributes to energy security.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$330,779

EPIC Funds Encumbered:

$3,999,900

EPIC Funds Spent:

$2,975,071

Match Partner and Funding Split:

Kevala, Inc.: $16,773 (0.4 %)

BMW of North America, LLC: $339,158 (7.6 %)

Bertrandt Consulting: $39,000 (0.9 %)

Sulzer US, LLC: $50,000 (1.1 %)

Match Funding:

$444,931

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

19 out of 21 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The existing iCharge Forward program developed trade secrets related to the vehicle telematics system and software used to administer grid service functionality between BMW's software backend and BMW electric vehicles. These trade secrets will be applied in this CEC project.

Update:

The recipient implemented and tested the control software at each of the home storage sites to assess grid and customer benefits when there was excess supply and demand response (DR) events. The default operation during these use cases maximized electricity bill cost savings by recharging the battery during the lowest cost hours, and discharging the battery when there is household electricity consumption. Project team also tested frequency regulation scenarios to assess the benefits of charging during off-peak periods and discharging during on-peak periods, and completed the renewable integration and overgeneration analysis and use case report. Two technical advisory meetings were held and a stakeholder engagement workshop held to publicize and receive feedback on the research results.

Project Name: EPC-15-085 - San Diego Libraries Zero Net Energy and Integrated Demand Side Management Demonstration Project

Recipient/Contractor: Center for Sustainable Energy

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

California has set goals for 50% of existing publicly-owned municipal buildings to be Zero Net Energy (ZNE) by 2025, and for 50% of existing commercial buildings to be ZNE by 2030. Public agencies are in a unique position to demonstrate ZNE and integrated demand side management solutions, and to share lessons learned to spur growth in these markets. Cost-effective pathways to achieving ZNE through energy efficiency paired with controlling electric demand are not widely proven. Further demonstration and analysis is needed to determine market viability and long-term sustainable savings, particularly in the municipal sector.

Project Description:

This project is a partnership with the city of San Diego to bring ZNE to three libraries. It integrates pre-commercial energy efficiency measures, building automation, control systems, and behind the meter solar photovoltaic to retrofit three existing public libraries in San Diego.

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

Combining energy efficiency and building automation with solar photovoltaics can result in an integrated approach capable of meeting the state's energy efficiency goals and providing demand response to provide grid flexibility. As the commercial sector, and local governments in particular, are risk averse, being able to demonstrate an integrated approach as well as document performance, benefits, and costs without disrupting municipal operations is key to encouraging greater adoption of the technologies. The successful implementation of technology will help other local governments and the commercial building industry budget, plan and prioritize these types of projects for existing building ZNE upgrades leading up to the state's 2030 requirements.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The project could reduce energy and demand costs by integrating a package of energy efficiency and demand reducing technologies. CSE estimates that the project will save the City of San Diego approximately $36,000 annually, collectively for all three libraries.

Public Health: The reduced energy consumption from the libraries will offset 186 lbs of NOx per year and help mitigate the energy impacts of providing "cool zone" services to the community during extreme temperature days in the summer months.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$725,052

EPIC Funds Encumbered:

$2,715,516

EPIC Funds Spent:

$1,070,557

Match Partner and Funding Split:

San Diego Gas & Electric Company: $60,000 (1.8 %)

City of San Diego: $482,000 (14.8 %)

San Diego Green Building Council: $1,568 (0.0 %)

ABM Electrical and Lighting Solutions Inc: $744 (0.0 %)

US Green Building Council - Los Angeles Chapter: $1,568 (0.0 %)

Match Funding:

$543,568

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

39 out of 39 bidders

Rank of Selected Applicant/ Bidder:

Group 5: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The execution of the subcontractors amendments took longer than anticipated and the lighting installation work will need to be accelerated in order to complete on time (3/31/2020). The recipient has finalized the construction contracts to install the remaining measures in January/February 2020.The team is also finalizing the marketing/promotion for each site to inform library visitors about construction and ZNE measures and benefits.

Project Name: EPC-15-086 - Substation Automation and Optimization of Distribution Circuit Operations

Recipient/Contractor: The Regents of the University of California, Irvine

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/22/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

To meet California's energy and climate policy goals, it is necessary to increase the penetration of distributed energy resources. These resources are controlled and operated individually and, as a result, may fail to achieve their full potential or create problems in the distribution system. The ability to control these resources as a group could overcome their challenges and enable this group to participate in wholesale markets. To provide the management and control needed to achieve these capabilities, detailed modeling and simulation of the dynamics of the system at the distribution level are required.

Project Description:

This project developed a Generic Microgrid Controller (GMC) to allow electrical substation control over grid assets, including generation resources, energy storage, and controllable loads. The GMC improved grid management at the distribution level. The team assessed different tariffs and interconnection agreements for a portfolio of scenarios to address the participation of DERs in the market. In addition, a fictitious retail/distribution market was developed and assessed.

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

This project led to technological advancement and breakthroughs by developing a control strategy to manage high penetrations of distributed energy assets (including generating resources, energy storage and controllable loads) as a single unit at a substation. The GMC managed dispatchable loads and generation, reducing stress on the grid by shedding unnecessary loads and dispatching generation as required. The GMC also includes an economic dispatch feature that determined the least expensive solution to serve all the loads.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1g, 3a, 3f, 5f

Lower Costs: The controller helps optimize dispatch of the available resources on the distribution system, which lowers operation costs by dispatching and utilizing available assets so that resources will be neither stranded nor under-utilized.

Greater Reliability: The controller provides visibility into the distribution system and will enable the operators to identify any issues quickly and respond to maintain system reliability.

Increase Safety: Enhancing automation and control capabilities of a substation allows for quick resolution of safety issues. Controlling load further allows for ensuring that the critical loads are being served in case of an emergency.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$124,021

EPIC Funds Encumbered:

$932,718

EPIC Funds Spent:

$915,543

Match Partner and Funding Split:

OPAL-RT Corporation: $35,978 (3.4 %)

The Regents of the University of California, Irvine: $76,303 (7.3 %)

Match Funding:

$112,281

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

23 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-086 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in March 2019. The final report is in process for publication. UCI completed the development and simulation, in partnership with SCE, of the GMC for enhanced substation control. The GMC showed optimal control of DERs on the distribution feeder while using the IEEE 2030.7 microgrid controller standard. UCI will create a hardware-in-loop test for the configuration using industry standard substation equipment. Although the hardware test was not funded through the grant, UCI is committed to validating the research results for purpose of grid modernization and informing stakeholders. The research results from this project informed the top power technology vendors, such as GE, Siemens, and Schneider Electric. A retail market was simulated and various tariffs were evaluated to determine benefits to developers, utilities, and grid stability.

Project Name: EPC-15-087 - Cooling Tower Water Treatment using Vortex Process Technology for Energy and Water Savings

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Chemical water treatment systems used to reduce scaling and inhibit biological degradation have typically been used in large central plants, industrial refrigeration plants, and other large cooling systems. Non-chemical treatment systems have the potential to reduce consumption of water by allowing more cycles of concentration in this equipment, as well as reducing the quantity and toxicity of discharge to wastewater treatment plants. The Vortex Process Technology has the potential to increase energy efficiency and reduce water use but there are uncertainties associated with long term performance, effectiveness, energy savings and cost effectiveness.

Project Description:

This agreement is funding the full-scale deployment demonstration of the Vortex Process Technology in cooling towers of commercial buildings. This technology has been used successfully in Europe and will be testing in California to address state specific goals for water and energy savings.

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

Non-chemical water treatment has the potential to reduce water use, improve quality of water discharged to wastewater stream, reduce scaling in condenser water piping, and increase energy efficiency of chilled water plants. The Vortex technology removes calcium carbonate from recycled cooling water and improves viscosity. By removing calcium carbonate physically it reduces the amount of chemicals used in calcium removal methods.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h, 4c, 4d, 4e

Lower Costs: This project has the potential to reduce energy and water costs in commercial buildings. The energy savings is due to improved cooling tower efficiency and heat transfer in cooling equipment. This project is estimated to reduce electricity use by 3 to 5 percent, excluding embedded energy savings from reduced water pumping and water treatment. The water savings is due to allowing higher cycles of concentration and supply water usage.

Increase Safety: Reduces use of hazardous chemicals, thereby reducing exposure of maintenance personnel.

Environmental Benefits: As less chemicals are used in the treatment of the water in cooling towers, this could reduce discharge of toxic materials into wastewater stream.

Public Health: Reduces exposure to toxic chemicals related to their manufacture, transport, handling, and disposal or use.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$485,121

EPIC Funds Encumbered:

$1,999,995

EPIC Funds Spent:

$1,085,309

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $324,990 (13.3 %)

Cypress LTD: $125,000 (5.1 %)

Match Funding:

$449,990

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 6

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-087 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

On 12/10/2019 the amendment was fully executed to extend the term by 3 months to 3/31/2019 and move funds between budget categories. Vortex system Team Data Analysis review received 11/12/2019. The following activities occurred in 2019: A) submitted an abstract to ACEEE summer 2020 study on this project as part of the Technology Transfer Activities. B) provided the a draft of the Technology Transfer Plan. C) drafted the Final Report and will be submitting for preliminary CEC review. D). prepared and provided the letters to transmit the equipment to the test sites: Amigen in Thousand Oaks and Marriott hotels (Westin in Rancho Mirage).

Project Name: EPC-15-088 - Biofiltration as an Advanced Primary Treatment Method to Achieve Substantial Energy Savings

Recipient/Contractor: Kennedy/Jenks Consultants, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

The secondary biological wastewater treatment process method is accomplished by aerating wastewater and is very energy intensive, typically accounting for 40 to 60 percent of the total wastewater treatment plant (WWTP) electricity consumption. Achieving a higher amount of removal of organic material before the aerated activated sludge process provides a breakthrough opportunity to reduce electrical power demand. However, biofiltration as an advanced primary treatment method is an emerging technology for removal of total organic load, both soluble and particulate material, and has never been implemented full scale at WWTPs.

Project Description:

The project is demonstrating that Biofiltration is a technically viable and commercially attractive approach to achieve significant electrical energy savings at wastewater treatment plants. This project is quantifying the electrical energy reduction and water savings that can be achieved by Biofiltration based on demonstration results at the Linda County Water District plant. This project will provide the cost and performance data to evaluate the benefits from a sustained, full scale validation testing, including quantification of electrical energy savings, determination of water savings, organic solids removal efficiencies, operation and maintenance and design criteria, independent monitoring and verification and technology transfer.

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

Biofiltration as an advanced primary treatment method could reduce the aeration electrical energy needed for secondary treatment, increase energy production in the anaerobic digester from the removed organic material and increase existing secondary treatment capacity and forestall the need for future treatment plants. Based on pilot studies outside of California, Biofiltration has the potential to decrease aeration power by 45 to 60 percent, increase gas production from 25 to 40 percent and increase treatment capacity by 50 percent.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: Aeration power requirements are estimated to decrease by approximately 45 to 60 percent compared to conventional treatment methods. Assuming 25% implementation of the technology, it is estimated that the annual electrical energy and cost savings for the wastewater treatment plant operators in California will be 110,000,000 kWh and $12,900,000 per year, respectively.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$442,698

EPIC Funds Encumbered:

$1,306,185

EPIC Funds Spent:

$740,216

Match Partner and Funding Split:

Professor George Tchobanoglous, Ph.D., P.E.: $12,000 (0.8 %)

WesTech, Inc.: $194,050 (12.3 %)

Linda County Water District: $24,700 (1.6 %)

Kennedy/Jenks Consultants: $41,000 (2.6 %)

Match Funding:

$271,750

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The method for backwashing the FlexFilter as well as the unique nature of the engineered bladder that provides a porosity gradient are both patented features of the FlexFilter. The applicable US Patent numbers are 7,223,347 7,143,781 as well as 7,435,351 and application 13/534,822. Any design criteria or specific information about the pilot unit must remain confidential.

Update:

The biofilter has been running since November 2018. Preliminary results are showing an average of 87% TSS removal from the primary influent and is exceeding expectations. Energy saving analysis has not been completed.

Project Name: EPC-15-089 - Expanding Standards and Developing Tools to Enable DNP3 Support of Energy Storage Use Cases

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/22/2016 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Operational Tools, Models, and Simulations to Improve Grid Resource Planning

Issue:

For smart inverters to communicate effectively with a variety of distributed energy resources, there needs to be a standard communication protocol. There has been significant development of DNP3 (Distributed Network Protocol) for smart inverter functions, but this has focused on communicating with solar photovoltaic systems. There is a need to expand and refine the DNP3 protocols to standardize communications to control energy storage functions.

Project Description:

The recipient developed tools to make adoption of DNP3 for communication and control of energy storage systems simple and seamless. The project evaluated the current state of communications to DERs, worked with the DNP3 Users Group to update the existing energy storage and solar specifications to support the most advanced energy storage use cases, created an open-source DNP3 client to simplify product development of smart inverters, and developed the appropriate conformance testing tools to ensure interoperability.

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

This project advanced the DNP3 protocol (communication standards for smart inverters) by making it simple and seamless while also improving communications with stand-alone energy storage systems and control of other inverter-based devices. This allows California to utilize more energy storage systems; thus, increasing the use of renewables and other DERs to support a more flexible grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed)

Applicable Metrics: CPUC Metrics- 1a, 1h, 1i, 2a, 3a, 5a

Greater Reliability: This project expanded the capability of utilities to control energy storage systems, which allows them to maximize the use of energy storage systems to provide a more reliable grid.

Environmental Benefits: Environmental benefits of this project stem from realizing the advanced use cases for energy storage that help reduce peaks and minimize the need for traditional generators to provide support at peak times, which will reduce the state's greenhouse gas emissions and improve air quality.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$187,517

EPIC Funds Encumbered:

$873,516

EPIC Funds Spent:

$871,676

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $105,228 (8.5 %)

MESA Standards Alliance: $75,000 (6.1 %)

SunSpec Alliance: $130,100 (10.5 %)

Xanthus Consulting International: $50,500 (4.1 %)

Match Funding:

$360,828

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

23 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-089 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in 2019 and the final report is in the process of being published. The team solicited inputs from a 150+ person international advisory group representing utilities, manufacturers, and researchers to identify gaps in the protocol for energy storage. The team concluded the project by performing conformance testing with other standards and streamlined the adoption through tech transfer, open source tools, and compliance testing. The standards for DER are relatively new, and this project created a framework for DNP3, which will allow organizations to be able to refine the technical and business aspects of testing. The DNP3 application note is used by both utilities and DER owners/manufacturers. IEEE 1547-2018 lists this DNP3 application note as one of three allowed protocols for managing DER.

Project Name: EPC-15-090 - Integrated Distributed Energy Resources Management System (iDERMS)

Recipient/Contractor: The Regents of the University of California (UC Riverside)

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/22/2016 to 1/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S6: Develop Technologies, Tools, and Strategies to Enable the Smart Grid of 2020

Issue:

The number of distributed energy resources (DER), such as solar photovoltaic panels, electric vehicles, energy storage devices, and flexible loads has increased exponentially in the past few years. Traditional distribution automation systems designed under a centralized control scheme can no longer handle the task of coordinating the control of thousands of heterogeneous devices. Better control solutions are needed to enable greater grid reliability as DER deployment increases.

Project Description:

This project developed an Integrated Distributed Energy Resource Management System (iDERMS) to coordinate the operation of a large number of DERs. In normal grid operations, the system would aggregate multiple DERs consisting of flexible loads, renewable resources, and energy storage systems. The DERs would be coordinated to optimize power flow and respond to a distribution system operator electricity market. In an emergency situation, the system would provide any needed reactive power support to the distribution grid with smart inverters. Additionally, the system would coordinate DERs on the distribution system to help restore the grid in the event of an outage.

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

The project will develop controls to create virtual generators by aggregating DERs. The aggregated virtual generators would be capable of providing energy shifting, frequency regulation, and flexible ramping services to mitigate the uncertainties brought by renewable generation. The iDERMS has the potential to increase renewable penetration, reduce GHG emissions and make virtual generators cost competitive with centralized power plants.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1g, 3a, 3f, 5a

Lower Costs: The project team estimated that the iDERMS will yield annual electricity savings of 4,840 GWh, distribution system peak reduction of 450 MW, and quantifiable electricity cost reduction of $360 million per year in California.

Environmental Benefits: The project team estimated this project will yield annual greenhouse gas emission reduction of 2.2 million metric tons in California by more efficient use of DERs.

Public Health: As virtual aggregation of DER increases, the DER can be coordinated to provide functions of fossil fuel power plants and reduce the use of fossil fuels, which will result in lower emissions and cleaner air. This will lead to improvement in health for California residents.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$97,356

EPIC Funds Encumbered:

$1,119,437

EPIC Funds Spent:

$874,400

Match Partner and Funding Split:

PetaPower, Inc.: $149,524 (9.1 %)

University of California, Riverside: $380,868 (23.1 %)

Match Funding:

$530,392

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

23 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-090 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team completed the iDERMS platform and all the associated software modules. The Recipient met with several technology vendors, utilities, and research institutions to disseminate the knowledge gained with possibility for technology vendors to adopt iDERMS in advanced distribution management system platforms. Interested parties include SCE, SMUD, LLNL, PNNL, CAISO, GE, Siemens, and Opus One Solutions. The draft final report was submitted in October. CAM review of the final report draft was completed in late October. The Recipient is currently working on the edits for report and adding content.

Project Name: EPC-15-091 - Energy Efficiency and Water Savings in Agriculture by Innovative Plant-Aware Irrigation System

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 12/30/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Current irrigation practices for California fruit crops, is to water according to a weekly schedule with a fixed quantity of water each time, or based on climate conditions, regardless of the actual water needs of the plants. This method results in over-irrigation and is often detrimental to the quality of the fruit or its yield.

Project Description:

This project addresses the specific problem of fixed watering schedules for agricultural crops by demonstrating a new irrigation system that saves both water and energy. This system performs on the principle that crops are watered only when needed, not just on a set time-interval. The additional benefits of this system are the improved quality and yield of the crop. The goals of this project are to demonstrate the Plant Aware Irrigation (PAI) system on perennial crops, quantify the energy and water savings, and engage customers' feedback of perceived benefits while acknowledging their concerns. The technology was demonstrated in three vineyards; Yountville, Napa and Livermore. Each site produced different type of grapes (cabernet sauvignon, pinot noir, and chardonnay) which enabled better insight into water/energy nexus related to each grape type.

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

The technology being demonstrated precisely detects when crops need water, triggering irrigation only when needed. Delivering less water reduces pumping and the associate energy use, lowering GHG emissions. Expanded deployment to other California perennial fruit crops has the potential to save significant amounts of energy and water, moving the state closer to its energy goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

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

Lower Costs: The project could lower costs to growers through reduced water consumption and reduced energy consumption from pumping well water. The statewide water savings conclude an estimated 297 billion gallons per year and about 403 million kwh of annual electricity savings. With an average electricity rate of $0.15 per kWh, the total savings estimate is $63 million to the CA ratepayers, for grape crops alone.

Environmental Benefits: The project achieved environmental benefits through demonstrating an average of 61% savings of water and energy over one growing season . Water is currently wasted by watering crops on a regular schedule while this technology will save water by watering based on plant needs. When the vines can adapt to receive less water early in the season, crop production is less sensitive to drought. Reduction in water use cuts down the need for water pumping and associated energy use, thus reducing greenhouse gas emissions.

Consumer Appeal: Limiting water to wine grapes could produce higher quality grapes as measured by earlier berry ripening, improved sugar per berry and individual berry weight, resulting in higher grade wines.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$220,794

EPIC Funds Encumbered:

$1,097,990

EPIC Funds Spent:

$854,033

Match Partner and Funding Split:

Fruition Sciences: $331,000 (23.2 %)

Match Funding:

$331,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-091 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project results estimated a 61% combined water and energy savings annually, compared to traditional irrigation. The project's final meeting was December 3, 2019. The fruit ripening conditions, quality and yield were not impacted by the optimized irrigation system. EPRI held a Pollinator Workshop and the project team presented to local farmers at Fresno State University (FSU) 2019 Innovations in Ag Irrigation Technology Showcase to highlight the emerging irrigation and water management technology. The FSU presentation will be featured in West Coast Industrial Solutions magazine. Future market transfer activities will be focused toward wine grape growers and water intense agriculture sectors. These opportunities will concentrate on the objectives and practical aspects to understand the requirements. The technology will also be applied to avocado crops under an

Project Name: EPC-15-092 - Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal

Recipient/Contractor: Tomorrow Water dba BKT United

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Many of California's groundwater aquifers are unused for drinking water due to contamination by nitrate and/or perchlorate. Existing groundwater treatment methods generate a concentrated brine stream that requires disposal measures rendering it unsuitable for inland sites. Existing biological treatment alternatives do not generate a brine stream but are very energy intensive. A cost effective, low energy treatment option for contaminated ground water resources is needed for inland communities in Central and Southern California to increase water supply.

Project Description:

The project is demonstrating a biofiltration system that uses 15-20 percent less energy when compared to conventional technology used to treat contaminated water to meet drinking water standards or for use in industrial and/or agricultural applications. The technology is being demonstrated in the City of Barstow and the focus is removal of nitrate, perchlorate and turbidity from the wastewater. The project includes water testing to secure Conditional Acceptance as a Title 22 drinking water treatment technology from the State Water Resources Control Board.

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

The project is anticipated to offer a lower energy alternative for treatment of the most common contaminants preventing use of ground water resources in California. The project could enable the development of new water supplies in many of the drought challenged regions of the State. Local treatment of impaired groundwater will provide additional energy benefits by eliminating the cost associated with transporting clean water from distant sources. The biofiltration treatment technology has the potential of efficiently treating contaminated water in an energy efficient manner while generating no waste brine.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

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

Lower Costs: The biofiltration system in this project yields cost savings through reduced energy use because the media used in the system is backwashed by gravity rather than pumping. Additionally, recirculation pumping, common in other biofiltration systems that use activated carbon, requires regular interval replacement. The BKT biofiltration technology uses a floating media and does not require regular replacement. The recipient estimates a 70 percent reduction in electricity costs and a 20 percent reduction in operating costs compared to typical up-flow treatment systems .

Environmental Benefits: This low energy system treats contaminated water so that it can be used as drinking water supply. This can provide a source of local drinking water and eliminates the need to transport clean water from distant sources. The system also does not generate brine which is a byproduct waste which typically require landfill disposal.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$1,722,072

EPIC Funds Spent:

$1,558,308

Match Partner and Funding Split:

Kana Engineering Group, Inc: $100,000 (4.7 %)

City of Barstow: $75,000 (3.5 %)

Khalil Kairouz Consulting: $5,000 (0.2 %)

Eurofins Eaton Analytical: $49,860 (2.3 %)

Tomorrow Water dba BKT United: $172,637 (8.1 %)

MWH: $15,000 (0.7 %)

Match Funding:

$417,497

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-092 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The Recipient finished the acclimation process to introduce microorganisms for colonization of the bioreactor. The biofiltration system is operating in continuous mode; it was previously running in batch mode as the Regional Water Board had concerns over the perchlorate concentration. The Recipient is currently in the Title 22 process. Recently, there were some issues with the effluent discharge area becoming over saturated so the recipient is rerouting the effluent but is evaluating a more permanent fix. Electricity data will be collected at the main submeter for the biofiltration system and compared to the baseline to calculate savings.

Project Name: EPC-15-094 - Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan, 2015-2017 Triennial Investment Plan

Project Term: 6/15/2016 to 3/30/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Demonstrate the Reliable Integration of Energy Efficient Demand-side Resources, Distributed Clean Energy Generation, and Smart Grid Components to Enable Energy Smart Community Development, S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

California's zero net energy and global climate change goals will require a huge increase in building and end-use system efficiency. The immediate goal of all new homes to be zero net energy by 2020 will require a better understanding of cost effectiveness, technical feasibility and operational performance. Large scale field demonstrations that show integrated technology pathways in multiple climate zones are needed to demonstrate cost effectiveness, monitor and verify energy and cost savings and other benefits, and evaluate new technology and integration strategies, such as community solar and impacts on the distribution grid.

Project Description:

This project is demonstrating cost-competitive ZNE design strategies that combine occupant needs with technology solutions to create new pathways for residential ZNE communities. The strategies will be demonstrated in single and multifamily buildings. The project's goals are cost effectiveness for the customer, affordability, overcoming customer apprehension, establishing a track record of new technology for builders, enabling distribution grid integration, creating a planning process for ZNE communities, evaluating community solar and evaluating the impact of future changes to ZNE cost effectiveness. This project also aims to understand the operation and energy use of the unregulated loads.

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

This research will provide new methodologies for integrating occupant and technology needs into a cost effective and scalable zero net energy (ZNE) strategy. The project will analyze and define the savings and market barriers in residential communities and

provide new, valuable performance data and models from the demonstrations. The products from this research will be essential to identifying the successes and barriers to meeting the ZNE goals for residential communities.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: Zero net energy (ZNE) homes could result in significant savings in money, resources, operation and maintenance, energy, and greenhouse gas emissions. Both ratepayers and customers benefit from implementing ZNE residential communities. The estimated cost savings related to the energy savings is $1,242/home/year. Over a 50-year life of a ZNE home, this would translate to a net present value of nearly $80,000 in realized value for the homeowners.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,460,838

EPIC Funds Encumbered:

$4,942,809

EPIC Funds Spent:

$1,208,495

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $676,007 (11.2 %)

Frenso Housing Authority: $200,000 (3.3 %)

LINC Housing Corporation: $233,475 (3.9 %)

Match Funding:

$1,109,482

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

39 out of 39 bidders

Rank of Selected Applicant/ Bidder:

Group 6: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-094 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Home construction has been completed for three sites: single family unit in Belmont and multifamily units in Compton and Pomona. The Fresno multifamily project will be completed June 2020. Ribbon cutting for the Belmont site is scheduled for 12/10/19. The project leverages the latest energy technologies that can support decarbonization.

Project Name: EPC-15-096 - Demonstrating Innovative Leakage Reduction Strategies: Correlating Continuous Acoustic Monitoring, Satellite Imagery and Flow Sensitive Pressure Reducing Valve System

Recipient/Contractor: American Water Works Company, Inc.

Investment Plan: 2012-2014 Triennial Investment Plan

Project Term: 6/30/2016 to 3/30/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Demonstrate and Evaluate the Technical and Economic Performance of Emerging Energy Efficiency and Demand-Side Management Technologies and Strategies

Issue:

Water utilities across the country struggle with aging pipe infrastructure, resulting in water loss from leaks. The loss of water in the water distribution lines means energy is being wasted because to produce potable water for delivery to customers requires substantial energy associated with treatment and conveyance--or the embedded energy in water. The longer the leak goes unidentified, the already treated water in the pipeline is wasted, along with all the energy used to produce and convey that water. Underground water leaks are difficult to detect and manage.

Project Description:

This project is demonstrating three leak detection technologies to reduce the amount of water lost from leaks and the amount of embedded energy wasted due to these leaks. The technologies tested include satellite imagery leak detection, correlating continuous acoustic monitoring, and flow sensitive pressure reducing valves. These technologies have site demonstrations in four Southern California cities. The Recipient will present achievable and measurable water savings in water distribution systems and show the potential for water and energy savings. An economic analysis of the costs and benefits of the technologies will be developed to assist in considering solutions for water loss reduction and energy efficiency. The project benefits will be quantified through water saved, embedded energy saved and associated greenhouse gas emissions reduced.

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

This project will advance the technical knowledge of detecting and preventing underground water leaks and estimating the energy savings associated with the water leak detection/prevention strategies. Identifying and demonstrating tools to help water agencies monitor, assess and manage their water distribution systems conserves water resources, increases water system reliability, lower emergency and repair costs and

reduces water and electricity costs for ratepayers. These benefits will be quantified through the volume of water saved and the embedded energy in the saved water.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 4c

Environmental Benefits: The technologies demonstrated in this research project provides information to water agencies on leaks in their system and to take action to repair leaky systems to save water. Water loss due to leaks impacts overall energy use due to the embedded energy associated with treating and transporting water that is no longer available due to leakage.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$222,664

EPIC Funds Encumbered:

$1,517,780

EPIC Funds Spent:

$1,345,378

Match Partner and Funding Split:

American Water Works Company, Inc.: $311,641 (16.3 %)

Hazen & Sawyer: $3,000 (0.2 %)

Echologics: $76,820 (4.0 %)

Match Funding:

$391,461

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 7

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-096 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Data collection and analysis is complete. The final report is being finalized with data collected. A presentation on the project was given at the American Water Works Association CA/NV Conference in Sacramento in March 2019.

Project Name: EPC-15-097 - Achieving Zero Net Energy in Multi-family Buildings

Recipient/Contractor: Build It Green

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/1/2016 to 3/30/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

There is a critical need for more research and evaluation of zero net energy multifamily design and construction approaches and practices. Many key design issues remain poorly understood in the multifamily sector, particularly for emerging all-electric heating, ventilating and air conditioning and domestic hot water technologies. These include the performance and economic trade-offs of technology solutions, lack of agreement between design and actual performance for key emerging technologies, and a lack of understanding of how these technologies will impact tenants and property managers.

Project Description:

This project demonstrates the potential of breakthrough electric water heating and space conditioning technologies as a pathway to zero net energy. The project explores the complex, interdependent systems in multifamily buildings and how they work together to achieve zero net energy status for the buildings in a cost-effective manner. Four multifamily buildings, designed to be affordable, are to be evaluated in various stages of design and development. These buildings share a goal of all electric zero net energy construction with 100 percent renewable energy generation, and utilize innovative new heat pump technologies to serve the buildings water heating and/or space conditioning needs.

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

The project demonstrates the technical and economic feasibility of zero net energy design for large multifamily projects and establishes design and installation best practices that minimize risks for developers. This includes documentation of best practices to ensure that energy and cost benefits of zero net energy are fully realized and identified, including the trade-offs between technology solutions, capital costs, operating and maintenance costs, environmental benefits and grid impacts.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: This project helps developers make more informed zero net energy design decisions which may reduce construction costs for multifamily buildings up to $2,000 per apartment and lower future operating (e.g., energy) costs for building owners and occupants.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$180,555

EPIC Funds Encumbered:

$1,955,811

EPIC Funds Spent:

$1,405,820

Match Partner and Funding Split:

Corporation for Better Housing: $245,000 (10.9 %)

MidPen Housing Corp.: $45,090 (2.0 %)

Match Funding:

$290,090

Leverage Contributors:

Pacific Gas and Electric Company: $350,498

Leveraged Funds:

$350,498

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-15-097 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Product name: Confidential Utility Consumption Data

Patented equipment. High temperature heat storage itself is not a novel or patented concept by GE, but new controls (e.g. software and firmware) and the existing Geospring heat pump are proprietary.

Update:

This project is on track. The construction of all four multifamily buildings in Sunnyvale, Atascadero, Cloverdale and Calistoga is now complete. The installation of domestic hot water monitoring devices such as meters, data loggers and sensors were completed for all buildings in 2018. Energy display installations, which uses colors to inform occupants in real time how much energy is being consumed, were installed at all sites March 2019. Data collection on DWH, thermal storage, HVAC, systems performance, electrical consumption, occupancy behavior will be completed by early 2020, then analysis to determine technical and cost effectiveness and how close each building is achieving Zero Net Energy will start. The monitoring period will be completed in May of 2020.

Project Name: EPC-16-001 - Measure Results from Affordable Zero Net Energy Homes

Recipient/Contractor: Institute of Gas Technology dba Gas Technology Institute

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/30/2016 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The California Energy Efficiency Strategic Plan includes four Big Bold Initiatives, one of which states that all new residential construction in California will be zero net energy by 2020. To help achieve this goal, demonstrated proof in the form of measured field performance of new and emerging technologies is needed to help overcome skepticism about the magnitude of the Plan's energy savings potential and cost-effectiveness.

Project Description:

The project implements lessons learned from previous high performance housing research and measures the results in two new homes being built in partnership with Habitat for Humanity in a disadvantaged community in Stockton. Both houses include advanced architectural design features, high performance enclosures, advanced heating, ventilating and air conditioning systems, and low-cost water heating systems. One all-electric home and one mixed fuel (combined electric and natural gas) home is being built to demonstrate the respective cost-effectiveness of each set of features. In addition to measuring actual performance of occupied houses, the project is developing a guide to affordable residential zero net energy design and construction along with a training curriculum, and will offer training opportunities based on the project results.

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

The technological advancement in this project is to utilize innovative construction approaches that couple advanced energy efficiency measures with integrated project design and delivery (IPD) in a cost-effective manner. These approaches aim to reduce structural framing to minimize heat paths through the walls, improve wall and attic insulation, increase equipment efficiency, reduce air infiltration levels, and improve water heater and HVAC performance. The approaches will emphasize minimum energy use, high indoor air quality, robust and appealing architectural design, solid structural integrity, and practical, low cost construction. If successful, these innovative approaches

could become standard construction practice leading to widespread deployment of affordable ZNE homes.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a

Lower Costs: The advanced integrated energy efficiency packages included in this project could reduce annual energy costs for homeowners by up to 50 percent.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$325,815

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$479,262

Match Partner and Funding Split:

Dettson: $8,500 (0.7 %)

Southern California Gas Company: $160,000 (13.7 %)

Match Funding:

$168,500

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Progress this year includes making significant headway on construction efforts which is anticipated to be completed by December 2019. Data measurement and verification plan was finalized for the two demonstration sites. Project team has also made substantial progress developing an eBook that details the innovative energy efficient construction practices being utilized. Project team has begun planning several builder training seminars in PG&E and SoCal Gas service territories.

Project Name: EPC-16-002 - Pathways to More Cost-Effective ZNE Homes

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/1/2016 to 6/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The State of California has set the goal for all new residential construction be Zero Net Energy (ZNE) starting in 2020. This is a dramatic increase in volume, going from ~40 units in 2014 to >150,000 units in 2020. To date, there are no comprehensive studies on the cost-effectiveness of ZNE homes, the dependence of cost-effectiveness on building type (single family versus multifamily; all-electric versus non all-electric) and geographical location, and the impact of high volume production of ZNE components. This project will address these deficiencies to help inform policymakers on the best methods for cost-effective implementation of ZNE homes.

Project Description:

This study provides detailed cost-effectiveness modeling of all electric, Zero Net Energy (ZNE) homes compared to mixed-fuel ZNE homes with gas-based heating. Evaluation includes costs of building integration, energy efficiency packages, installed equipment, and lifetime investment costs. The project provides spatial and temporal analyses to enable an assessment of cost-effectiveness in four California climate zones. This information will help policy makers better understand the cost and benefit tradeoffs of ZNE policy - and allow for more informed planning to reach ZNE targets in 2020 and 2030. It will also provide the information on the climate trade-offs of all electric homes compared to those with electric and gas service.

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

The project identifies key cost-reduction opportunities to inform future policy decisions and includes development of cost data on photovoltaic cost reduction potential, building shell measures, and future end-use appliance costs and performance and estimates of cost sensitivities of various ZNE related issues. The latter includes offsite renewable energy procurement, climate impacts, and policy levers, such as mortgage tax credits and incentives.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: When project recommendations are implemented by builders, it could result in reduced construction costs for builders and operating costs for homeowners. This will result in a lower cost ZNE home due to economies of scale in manufacturing and lower energy bills for the occupant.

Greater Reliability: When project recommendations are implemented by builders, it could result in increased grid reliability by reducing demand side load and increasing adoption of distributed energy resources.

Environmental Benefits: This project could reduce greenhouse gas (GHG) emissions by providing the building industry with the most cost-effective approaches toward implementing renewable energy and energy efficiency measures into community development projects. When project recommendations are implemented by builders, it could result in offset of end-use demand and avoided capacity needed at the generation level and potential reduction of GHG emissions associated with that demand.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$436,541

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$1,000,000

Match Partner and Funding Split:

Lawrence Berkeley National Laboratory: $50,000 (4.8 %)

Match Funding:

$50,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project is complete. The final report was received. A few key takeaways from the project are:

- New all-electric homes have comparable 30-year lifecycle costs to mixed-fuel homes when cost optimized for 2019 Title 24 compliance while offering significantly lower CO2 emissions (average of 38% lower).
- All-electric home costs can benefit from reduced infrastructure costs for gas lines.
- All-electric single-family homes with cost-optimized designs have an average of 1kW larger solar PV system sizes compared to mixed-fuel homes to offset increased electricity consumption.
- Full ZNE home can be achieved by oversizing solar PV systems to offset the TDV of building's total annual site energy usage

Project Name: EPC-16-003 - Pilot-Scale Evaluation of an Integrated Building Control Retrofit Package

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/18/2016 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The traditional approach to building automation consists of a collection of independent control systems, one for each building end use, with limited or no communication among the individual devices. Several research efforts during the past decade were aimed at improving electric lighting or fenestration control methods, increase system reliability and reduce lighting energy use. However, few efforts accounted for the interdependence of lighting, fenestration and space conditioning systems and the consideration of the latter in an integrated approach to optimize whole building energy efficiency via a single, unified control platform.

Project Description:

This project tests an integrated building control package that maximizes energy efficiency for existing commercial buildings. The project refines novel control algorithms that utilize shared device state and environmental data for lighting, fenestration and heating, ventilating and air conditioning (HVAC) systems. Sharing data from multiple device types will further improve overall, sustained, system performance and operation. Control algorithms prioritize lighting or heating/cooling savings based on climate and building design. HVAC system management leverages passive ventilation through windows and skylights and dynamic adjustment of HVAC set point dead bands.

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

This project seeks to improve sensor-controlled lighting and air conditioning systems by integrating and sharing information from multiple sensors, resulting in better quality indoor spaces with reduced energy cost. This research will focus on refinement and testing of an Integrated Building Control Retrofit Package. The includes the refinement of novel control algorithms that utilize shared device state and environmental data among lighting, fenestration and HVAC devices. This is a breakthrough because most lighting and HVAC controls operate independent of each other and this project hopes to integrate both.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h, 3e

Lower Costs: This project could lower energy bills to commercial building owners that implement these control retrofits for HVAC, lighting and fenestration in their buildings.

Consumer Appeal: This project will develop systems which improve the functionality of lighting and heating, ventilating and air conditioning controls, and integrate operations with automated shading, natural ventilation, and air conditioning systems, to create more and comfortable indoor environments.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$349,266

EPIC Funds Encumbered:

$1,999,089

EPIC Funds Spent:

$1,067,673

Match Partner and Funding Split:

Regents of the University of California, Davis - California Lighting Technology Center: $267,363 (11.8 %)

Match Funding:

$267,363

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient started installation in July 2019 at the demonstration site, the Barn, on the UC Davis campus. The recipient will install controllable window shades, smart thermostats, and lighting with controls and will determine whether the lab scale control algorithms work in real world conditions.

Project Name: EPC-16-004 - Integrated Whole-Building Zero Net Energy Retrofits for Small Commercial Offices

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/30/2016 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Small commercial offices in California consume about 3,500 GWh of electricity annually. This usage is projected to increase due to increasing use of office electronics and decarbonization driven fuel-switching of space and water heating systems. As a result, the need for deep reductions in electricity usage is needed. However, this sector faces a number of barriers to achieving these energy reductions, including lack of awareness on how to achieve energy targets and integrated solutions, and affordable access to energy reduction services such as engineering and auditing services. Energy efficiency tools and services currently involve high costs on a per-square-foot or kWh-saved basis.

Project Description:

This project develops and evaluates cost-effective packages of pre-commercial integrated energy efficiency measures and controls to achieve zero net energy (ZNE) performance for small commercial offices in California. The project team is utilizing Lawrence Berkeley National Laboratory's FLEXLAB to test whole-building integrated systems under varied climate and use conditions, with additional testing to be conducted at a retrofitted office building in Berkeley, CA. The team is aiming to achieve a minimum of 50 percent energy savings over baseline conditions at the retrofit site to achieve ZNE. Data on energy, occupant comfort, and occupant behavior are being analyzed to identify best practices that can be replicated elsewhere in the State.

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

This project develops and validates integrated whole building retrofit packages using pre-commercial underutilized technologies and controls with the goal of reducing energy use in small commercial offices by at least 50 percent. The project also aims to increase system reliability by reducing peak energy loads and potentially supporting automated demand response implementation. The energy efficiency and demand reduction components of the project provide a path towards meeting the State's energy efficiency and climate goals along with a means to replicate these strategies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: The project aims to reduce energy use by at least 50% in small commercial offices.

Environmental Benefits: Assuming 5 percent of small commercial buildings (less than 30,000 square feet) in California adopt the proposed retrofit measures (including on-site renewable energy generation) by 2030, greenhouse gas emissions could be reduced by 83,238 metric tons per year.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$781,092

EPIC Funds Encumbered:

$2,000,000

EPIC Funds Spent:

$1,760,556

Match Partner and Funding Split:

Northern California test site partner: $2,000,000 (50.0 %)

Match Funding:

$2,000,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Progress this year includes participating in the 2019 EPIC Symposium poster session, selecting a contractor to implement the retrofits, obtaining City of Berkeley approval for ZNE retrofit work to begin, and completing FLEXLAB testing of retrofit technologies to be deployed at the city test site. Project team continues to analyze data from FLEXLAB testing and integrate findings into an online commercial building energy modeling tool. Project outreach activities were also completed such as presenting at conferences including AEE West Conference in Santa Clara and New Buildings Institute's Getting to Zero Forum in Oakland.

Project Name: EPC-16-005 - Energy Efficient HVAC Packages for Existing Residential Buildings

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/1/2016 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

To meet California's long-term energy efficiency plan, existing buildings must be retrofitted for energy efficiency to bring them on par or exceed current California efficiency building standards. Specifically, cooling of single-family homes will account for more than 5,700 GWh annually by 2024. While several new heating, cooling and ventilation (HVAC) technologies exist for improving energy efficiency, research and development is needed to create cost-effective retrofit packages for existing buildings, and to identify opportunities to encourage widespread adoption of these packages.

Project Description:

This project demonstrates innovative pre-commercial, cost-effective retrofit packages for cooling and ventilation for single-family homes. Energy savings, occupant behavior and indoor air quality (IAQ) are to be measured for two specific retrofit packages that each includes three innovative technologies: (1) building envelope sealing, (2) two variants of smart mechanical ventilation that include pre-cooling strategies, and (3) mostly compressor-free evaporative air-conditioning. Furthermore, barriers and opportunities towards adoption of such retrofits will be identified through stakeholder interviews.

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

To address the current issues with indoor air quality and energy efficiency in existing homes, this project evaluates two residential retrofit packages that incorporate advanced technologies for achieving both of these goals. Better envelope tightness combined with a dedicated ventilation system and highly efficient evaporative cooler will increase indoor air quality, reduce energy use for air conditioning and reduce overall peak demand. Additionally, the technology could reduce energy costs for building owners/occupants.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: This retrofit package could reduce HVAC energy costs in existing buildings by over 50 percent through the use of compressor-less cooling technology. The project also hopes to identify opportunities to encourage widespread adoption of the attic package by promoting to utilities and builders, thus potentially reducing deployment costs.

Environmental Benefits: The demonstration packages could reduce energy consumption and thus reduce greenhouse gas emissions, especially during peak demand hours. The energy savings is estimated to reduce greenhouse gas emissions by 56,000 metric tons per year by 2024. Also the evaporative cooling system provides an alternative to vapor compression cooling that reduces the usage of refrigerants are known to contribute to global warming.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$366,421

EPIC Funds Encumbered:

$1,200,000

EPIC Funds Spent:

$478,902

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

Western Cooling Efficiency Center - UC Davis: $126,000

Leveraged Funds:

$126,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

One year of baseline and six months of field monitoring were completed with the Smart Vent and Night Breeze systems along with the sub wet bulb evaporative cooling and DX coil. Two unique retrofit packages were installed in December 2018. Post monitoring started in early June 2019. Both sites received aerosol envelope sealing, and a sub wet bulb indirect evaporative cooling (IDEC) with a fresh air vent system. A small add-on direct expansion coil was added to each IDEC unit to allow for extra cooling during summer temperatures. Indoor air quality measurements monitored CO2 and PM 2.5. Initial results show that the home with the single cold water coil in the attic from the IDEC met the home's temperature requirements, but the home with the multiple mini-splits system supplied by the IDEC was unable to keep occupants cool. Recipient currently analyzing the data to make improvements.

Project Name: EPC-16-006 - Low Energy, Zero Liquid Discharge Adsorption Technology to Remove Contaminants and Recover Source Water

Recipient/Contractor: ES Engineering Services, LLC

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/28/2016 to 3/23/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

In California, many groundwater sources cannot be used for drinking water because of arsenic, chromium and other contaminants. Current technologies to treat contaminated drinking water are expensive, complex, and energy intensive, such as reverse osmosis. Other factors driving costs higher for conventional treatment include the need for expensive chemicals, daily management of high volume of waste laden with contaminants, and active process control, monitoring and adjustment. An alternative treatment system is needed that can effectively remove heavy metal contaminants from water, minimize energy, operation and waste disposal costs and meet California drinking water standards.

Project Description:

The project is testing an innovative, low energy, zero liquid discharge water treatment system using adsorption process to potentially remove arsenic and other contaminants from a groundwater reservoir. The project is developing a demonstration-scale water treatment system to determine operational costs, energy and water savings of the single use adsorption system The demonstration will validate the reduction in spent adsorption media by natural dehydration to further save energy and water associated with residual solid waste handling. The project includes testing and reporting to secure state mandated acceptance of the novel drinking water treatment technology.

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

This project could result in an innovative way to treat water with high amounts of metal contaminants using a low energy treatment method to restore impaired drinking water sources. The hydrogel adsorption process offers benefits of being simple, with its minimal amount of equipment required and can save water that would normally be too difficult to treat. This treatment method is especially suitable for small inland treatment systems, where liquid backwash and brine disposal may be cost prohibitive or infeasible.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 1h, 4c, 4d

Lower Costs: This project could lower the cost of treating water contaminated with heavy metals and allowing it to be reused. The energy reduction compared to conventional technologies is estimated to be 20-30 percent when applying this new, low energy technology.

Environmental Benefits: Resurrecting groundwater wells that have been removed from operation due to contamination offers energy and cost savings by avoiding the need for additional drilling and construction of new wells. Additionally, if successful, this project can improve water resources by removing heavy metal contaminants from water.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$986,262

EPIC Funds Spent:

$650,977

Match Partner and Funding Split:

Enova Water LLC: $65,000 (5.5 %)

AQUAlity Engineering, Inc.: $15,474 (1.3 %)

Khalil Kairouz Consulting: $4,000 (0.3 %)

Municipal Management Group, Inc.: $5,000 (0.4 %)

ES Engineering Services, LLC: $105,430 (8.9 %)

Match Funding:

$194,904

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Enova has pre-existing intellectual property that is relevant to the project. The intellectual property is the single use adsorption media for metals, and is currently patented.

Update:

The recipient is continuing the measurement and verification of the system, and, due to minor equipment issues, has been cautiously proceeding with water treatment.

Project Name: EPC-16-007 - Optimization of Energy Efficiency to Achieve Zero-Net Energy in Multifamily and Commercial Buildings

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/1/2016 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The technical feasibility of achieving Zero Net Energy (ZNE) in many building types in California has been documented, but the optimal cost-effective strategy to reduce net electricity consumption toward ZNE goals remains unclear. The number of building types and technologies are too numerous to answer performance and cost-effectiveness questions through field studies. The open-source software tools and analysis methodologies are difficult to monetize and would require coordination among competitors, and are not being developed nor funded by competitive markets.

Project Description:

This is a modeling study. The recipient uses EnergyPlus, a building energy modeling tool, to analyze the cost-effectiveness of various electricity saving/generation measures for multifamily and commercial buildings in California. Each building type and climate zone will receive a cost-benefit analysis for each measure individually and an optimized package of measures to achieve as close to zero net energy as is cost-effectively possible.

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

This project will accelerate the adoption of cost-effective electricity saving and generation technologies, equipment, materials and construction practices in California multifamily and commercial buildings.

By developing new methods and expanding on existing modeling methods using OpenStudio, a building energy modeling software developed by the Department of Energy, this project aims to enable rapid evaluation of energy efficiency packages to determine the most cost-effective approaches to achieve zero net energy buildings.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h, 3e

Lower Costs: This project could influence construction practices in California and promote the development of affordable energy efficiency in commercial and multifamily buildings. This project will provide optimized recommendations for cost-effective electricity saving solutions for a wide variety of California's building portfolio in all 16 climate zones. Detailed modeling of building energy modeling packages will allow for accurate determination of cooling and heating loads, enabling right sizing of equipment which could extend equipment life for building owners. Equipment right sizing would provide lower costs due to smaller equipment sizes and potential for lower maintenance costs.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$151,821

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$582,314

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $25,000 (2.3 %)

Regents of the University of California, Davis: $80,000 (7.2 %)

Match Funding:

$105,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Specifying the parameters for each technology and developing a cost data format that is appropriate for the cost model is ongoing. The recipient recently provided a presentation on preliminary modeling results and methodology for screening measures based on marginal costs of energy from photovoltaics. By assessing each efficiency measures relative costs versus installing additional solar generation the recipient is able to prioritize measures by cost-effectiveness.

Project Name: EPC-16-009 - Testing a Low-Energy Water Treatment System for Fail-Safe Direct Potable Reuse

Recipient/Contractor: Porifera, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/31/2016 to 8/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Potable water demand in California will continue to grow even as droughts become more common. The main sources for new water supplies in California are importing more water over long distances, desalination, and reuse. Of these three options, reuse requires the least amount of energy. A direct potable reuse (DPR) project has not yet been permitted in California. The main hurdle is public and regulatory concern over the public health risks of implementing DPR, which some call "toilet to tap". This concern is perpetuated by the lack of real-time fail-safe methods to ensure that contaminant barriers are intact at all times and performing as designed.

Project Description:

The project is testing a low-energy, dual barrier, direct potable reuse system, known as dprShield, with breach-activated barrier technology to demonstrate that this technology can improve public health safeguards and reduce the electrical energy, chemical consumption, maintenance and overall cost for potable reuse of municipal wastewater. While being energy efficient and cost-effective, this system effectively removes trace contaminants through two tight membranes. In the event that one of the membrane barriers is breached, a Breach Activated Barrier is triggered and the contaminants are pushed away from the clean water stream, ensuring safe operation in real time. This direct potable reuse technology could replace more energy intensive processes.

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

This project demonstrates an energy efficient solution for direct potable reuse of municipal wastewater. The dprShield is estimated to use 65 percent less energy than State Water Project transfers, 75 percent less than desalination and more than 50 percent less energy than competing technologies for direct potable reuse of municipal wastewater, removal of contaminants from water and real-time membrane integrity monitoring.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

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

Lower Costs: This project has the potential to provide a reliable and cost effective solution for water and wastewater treatment. This project could reduce water treatment and reuse costs, and reduce energy requirements and emissions when compared to other treatment methods.

Increase Safety: This project can increase safety and reliability of potable water reuse projects. As potable reuse grows in California, this advancement will help overcome barriers by demonstrating an energy efficient solution for removal of contaminants from water and real time membrane integrity monitoring. This technology could detect and react to small breaches and assure pathogens do not enter the clean product water when there is a breach. The dprShield was successful in rejecting more than 99% of contaminants.

Public Health: This project can increase safety and reliability of potable water reuse projects. As potable reuse grows in California, this advancement will help overcome barriers by demonstrating an energy efficient solution for removal of contaminants from water and real time membrane integrity monitoring. This technology detects and reacts to small breaches and assure pathogens do not enter the clean product water when there is a breach.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$248,634

EPIC Funds Encumbered:

$999,795

EPIC Funds Spent:

$881,325

Match Partner and Funding Split:

Leland Stanford Junior University: $34,784 (3.0 %)

City of Hayward: $10,000 (0.9 %)

Orange County Water District: $70,000 (6.1 %)

Porifera, Inc.: $30,000 (2.6 %)

Match Funding:

$144,784

Leverage Contributors:

United States Bureau of Reclamation: $2,826,591

Leveraged Funds:

$2,826,591

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Patents and trade secrets from Porifera, Inc. have been identified as relevant pre-existing intellectual property.

Update:

The final report has been submitted. The pilot demonstration results show that the dprShield uses 33% less energy than competing DPR solutions and 70% less energy compared to desalination.

Project Name: EPC-16-010 - Improving Water and Energy Efficiency in California's Dairy Industry

Recipient/Contractor: The Regents of the University of California on behalf of the Davis campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 10/1/2016 to 9/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Milk is the most valued agricultural commodity in California. Approximately one of five dairy cows resides in California. Heat stress remains a major cause of diminished milk production and increased disease among lactating dairy cows, with annual losses directly related to heat stress exceeding $800 million. Current methods of reducing thermal stress require significant amounts of energy and water. Evaporative cooling is typically used with water sprayed on the cows using feed line soakers. These approaches require large amounts of energy to pump water and move air in sufficient quantities to reduce heat stress. The resulting hot, moist environment promotes bacterial growth.

Project Description:

This project tests and demonstrates two novel approaches to cooling livestock. With conduction cooling, the bedding area beneath the cow is cooled using heat exchange mats below the stall bedding. To reduce energy consumption, water flowing through the heat exchange mats is chilled using a novel Sub-Wet Bulb Evaporative Chiller. The second approach, targeted convection cooling, uses fabric ducting to direct cool air on the cows. The air is cooled using high-efficiency direct evaporative coolers. Both approaches promise significant water and energy savings, when compared to current approaches.

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

This project advances management strategies for reducing thermal stress in dairy cows while also reducing energy and water use. There are two methods of reducing thermal stress in cows: (i) lowering the cow's heat exposure and (ii) increasing the cows ability to get rid of excess body heat. Current practice includes use of evaporative cooling with water sprayed on the cows using feed-line soakers, and cooling is enhanced by convective heat transfer via large overhead fans. This project will test and demonstrate an innovative approach that seeks to optimize the cow's ability to remove excess body heat by utilizing more efficient cooling technologies, and introducing alternate strategies

for when and where to cool the cows. By combining these two approaches this project has the potential to significantly change the way dairy cows are cooled.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: By optimizing cow cooling operations this project could reduce water use by up to 86 percent and energy use up to 38 percent. By reducing energy and water usage the dairy owners will see reduced utility, operating and maintenance costs. The conduction cooling approach has the potential to reduce water consumption by 73 percent and electricity consumption by 38 percent compared to the baseline. The targeted convection cooling approach has the potential to reduce water consumption by 86 percent and electricity consumption by 28 percent compared to the baseline.

Environmental Benefits: This project could reduce greenhouse gas emissions by integrating novel energy efficiency cow cooling technology at dairies. This technology could reduce energy and water use over traditional cow cooling methods and thus reduce greenhouse gas emissions associated with avoided capacity needed at the generation and associated with the embedded energy in water. In addition to saving electricity, this technology has the potential to increase milk production due to reduced heat stress as well as reducing disease among lactating cows.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$191,936

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$519,360

Match Partner and Funding Split:

Regents of University of California, Davis: $164,710 (14.1 %)

Match Funding:

$164,710

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

27 out of 35 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

(1) US Patent 9,207,018 Sub-wet bulb evaporative chiller system with multiple integrated subunits or chillers.

(2) US Patent 8397677 B2 Thermal Conductive Cooling Method and System for Livestock Farm Operations

(3) Targeted Convection and Hybrid Cooling of Dairy Barns

Update:

Installation and testing of the full-scale system has begun in Pixley, CA. Data collection on the "ducted" strategy is ongoing. Data collection will be limited during the winter period, but if temperature thresholds are met the data will be collected. The recipient will work on data analysis for the current sample period and provide preliminary results and conclusions to CEC staff over the winter of 2019.

Project Name: EPC-16-011 - Novel Membrane Technology to Improve Energy Efficiency and Water Savings in Wastewater Treatment Operations

Recipient/Contractor: Kennedy/Jenks Consultants, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/1/2016 to 4/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Low-pressure membrane filtration, such as microfiltration and ultrafiltration, is used for drinking water, wastewater, and industrial water treatment. However, membrane treatment processes are energy intensive, largely due to membrane fouling (organic and inorganic) on the membrane surface and in the membrane pores which results in layered fouling that is difficult to remove and increased transmembrane pressure. The use of membrane treatment is likely to increase due to its ability to remove pathogens during drinking water treatment compared to conventionally used media filters, and to recent state initiatives to increase water reuse.

Project Description:

This project was to demonstrate and assess the potential of an innovative amphiphilic, anti-adhesive membrane technology (developed by membrane manufacturer, inge/BASF) designed to minimize foulants onto membrane surface to improve the performance of membrane filtration systems used by drinking water and water reclamation agencies.

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

A survey by the American Membrane Technologies Association (AMTA) indicates that there are approximately 100 microfiltration/ultrafiltration treatment plants with a total design capacity of approximately 400 MGD, eight nanofiltration facilities (30 MGD), and over 100 reverse osmosis (RO) facilities (400 MGD) in California. As membrane treatment is energy intensive due to fouling, this technology could reduce energy demand for membrane treatment processes while decreasing the water need for backwashing.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: Although this product is not market ready, it does have potential for energy savings. Even the variable performance observed during these pilot tests, the R&D membrane provided an average of 6 percent energy savings.

Environmental Benefits: The technology could minimize chemical use for membrane cleaning and increase water yield by approximately 12 million gallons per day, or the amount of water for 58,000 people.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$304,611

EPIC Funds Encumbered:

$882,430

EPIC Funds Spent:

$736,251

Match Partner and Funding Split:

California Water Services: $20,000 (2.0 %)

BASF: $60,000 (6.1 %)

Kennedy/Jenks Consultants: $18,600 (1.9 %)

Match Funding:

$98,600

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is complete. The pilot test showed that use of the amphiphilic membrane could be effective in minimizing membrane fouling and promoting energy efficiency, but that differences in water source or quality impact the extent of those performance improvements. Overall process energy usage under all pilot testing conditions was reduced by approximately 6 percent. However, chemical degradation of the membrane surface occurred during testing indicating that further work may be needed on the part of the manufacturer to evaluate special chemical resistance specifications and cleaning protocol. The results suggest that the ultrafiltration membrane module has potential benefit but is not yet market ready.

Project Name: EPC-16-012 - Power and Water Saving Advanced Hybrid Air/Wet Cooling System

Recipient/Contractor: Altex Technologies Corporation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/12/2016 to 9/30/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Advanced hybrid air/water cooling systems for refrigeration and power systems represent an important opportunity, as they have the potential to reduce electricity and water use, an important consideration in California and many other water challenged areas in the United States. However, conventional hybrid air/wet cooling systems have high capital and electric power costs, which constrain their use in many commercial/industrial and utility applications.

Project Description:

This project uses high performance porous fins to enhance cooling through water vaporization and mass transfer. By retrofitting the heat exchanger with a water spray feature, this project has the potential to reduce energy and water use of HVAC and refrigeration systems in California. The developed Advanced Hybrid Heat Exchanger (AHHEX) only uses water when ambient temperatures rise above 85 degrees F. The ambient air temperatures in California rise above this level only a limited number of hours per year. This means that the AHHEX will have lower energy needs when the air temperature is low and water not used, compared to a conventional systems.

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

When compared to conventional condensers, the hybrid cooling system increases performance and lowers capital costs. This is accomplished by reducing the pressure drop, using water evaporation when ambient air temperatures are high, and reducing the volume weight. All of this translates to 50 percent lower heat exchanger volume, weight, cost, and reduced fan power cost.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

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

Lower Costs: Based on the test results extrapolated to a 170 tons cooling application, the AHHEX reduced water use by up to 2.1 million gallons/year and reduce energy use by 28,499 kWh/year. This translates to about $4,500 in annual savings assuming an average electricity cost of $0.156/kWh. If AHHEX was implemented to only 20 percent of the commercial and industrial markets in California, it is estimated that the AHHEX would annually save over 3 million kWh and 300 million gallons of water. This translates to over $500,000 in annual savings to commercial and industrial facilities.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$529,685

EPIC Funds Encumbered:

$999,994

EPIC Funds Spent:

$840,227

Match Partner and Funding Split:

Altex Technologies Corporation: $187,207 (15.8 %)

Match Funding:

$187,207

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Altex will include pre-existing intellectual property. A patented advanced porous fin heat exchanger technology that enhances wet and dry cooling heat exchanger performance will be adapted for the application of interest by adding water spray features, to produce an effective hybrid air/water cooling system, called Altex Hybrid HEX (AHHEX).

Update:

Testing for the hybrid heat exchanger and parameter optimization was completed and final report was submitted and is under review. Relative to conventional condensers, the Advanced Hybrid Heat Exchanger (AHHEX) can reduce evaporative cooler yearly water use by up to 98.7 percent for a 170-ton example cooling system operating in Oakland at constant load. The water and electric power reductions is expected to be up to 2.1 million gallons/year and 28,499 kWh/year, respectively. While the test system capacity was smaller than the targeted commercial and industrial markets, the AHHEX is modular and capacity can be added by duplicating and connecting panels in parallel to the larger chiller. Data from this project can be applied to full-scale commercial and industrial condensers and AHHEX can be scaled to range of applications.

Project Name: EPC-16-013 - Integrating Smart Ceiling Fans and Communicating Thermostats to Provide Energy-Efficient Comfort

Recipient/Contractor: The Regents of the University of California on behalf of the Berkeley campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/8/2016 to 3/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Conventional thermostat-based control strategies for heating, ventilating and air conditioning systems use a narrow range of temperatures year-round that are prescribed by building operators, based on an assumed occupancy schedule. Operators and occupants typically do not optimize these schedules based on actual occupancy or actual occupant preferences for thermal conditions. At low speeds, ceiling fans may reduce heating energy use by de-stratifying room air temperatures. However, architects, engineers, and owners do not understand the effects of air movement from ceiling fans to predict energy and comfort impacts that might result from new and innovative approaches to comfort.

Project Description:

This project develops an optimal system configuration for smart comfort controlled ceiling fans integrated with learning thermostats. This system is to be tested and evaluated for energy performance and occupant acceptance in low income multi-family residential and small commercial buildings in disadvantaged communities in California. This research and development advances the solution's technology readiness level and support market adoption acceleration. A design guide and energy code language are to be developed to facilitate widespread adoption.

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

Air movement, such as through ceiling fans, can cool a person indoors in a similar manner as lowering the temperature, but uses only a tiny fraction of the energy required by HVAC systems. New smart ceiling fans, using only 1-8 watts (compared to 2000-3500 watts for the typical 1.5-3 ton air conditioning system) and producing 1.5 to 2 mph air movement near building's occupants, can offset a 6°F increase in indoor air temperature. This improves the occupant's comfort and perceived air quality while substantially decreasing energy consumption. Allowing higher indoor temperatures reduces a building's

total HVAC energy by an average of 5% per degree Fahrenheit, and even greater in climate zones where natural ventilation or evaporative cooling systems are used instead of compressor-based cooling, or where there are a large number of airside economizer hours (such as California).

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: Developing cost-effective configurations and best practices will reduce the cost of adoption and operation while reducing the simple payback, thus enabling building owners to invest in the technology at lower risk. The recipient estimates that the integrated solution can provide energy savings up to 37% in cooling and 15% in heating, which could add up to 985 GWh of annual energy savings for California or approximately $148,000,000. The solution is a key component for passive heating and cooling design which supports CA zero-net energy (ZNE) goals and is demand-response ready.

Environmental Benefits: Energy savings could add up to 719 million pounds of greenhouse gas emissions reduced assuming a 15 percent market penetration. Also, ceiling fans are enabling technology for compressor-free cooling with passive and/or radiant systems because they provide comfort at higher indoor temperatures, thereby reducing refrigerant purchase, use and disposal.

Consumer Appeal: Automated learning controls make the technology operation easier for the customer and likely resulting in wider user acceptance. User acceptance is key to achieving broad adoption and meeting energy savings targets.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$188,176

EPIC Funds Encumbered:

$1,888,683

EPIC Funds Spent:

$974,902

Match Partner and Funding Split:

Center for the Built Environment - UC Berkeley: $112,726 (5.1 %)

BIG ASS FANS: $203,200 (9.2 %)

Match Funding:

$315,926

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

39 out of 39 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team installed 99 smart ceiling fans and learning thermostats/ sensors in offices, community rooms, and homes in low-income housing developments in four Central Valley locations. The fans act as the first stage of cooling, providing comfort and instant control to the occupants. As temperatures rise indoors, the fans gradually speed up. The air conditioning system only starts running when the indoor temperature is substantially higher (78 or 80 degrees Fahrenheit) than usual thermostat settings (70-75 degrees Fahrenheit). The team completed monitoring and collecting data from all sites, and currently analyzing the data. In addition, the team is currently working on the Fan Design Tool and lab testing for ASHRAE 2016 d.

Project Name: EPC-16-014 - A New Solution to California's Energy and Water Challenges: Reducing the Cost of Desalination and Increasing Water Reuse

Recipient/Contractor: Lawrence Livermore National Security, LLC

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/1/2016 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Desalination is currently the primary method of removing salt from industrial and municipal wastewater for reuse. However, this technology is energy intensive and expensive. Industrial processes and household activities continuously add salt to water, and as a result, the salt content of industrial and municipal waste water is often too high for reuse. The salt content of this waste water must be reduced to enable recycling and to avoid ecological damage but the technology must be more energy efficient compared to current practice.

Project Description:

This project is demonstrating how to reduce the energy used to remove salt from wastewater using the flow-through electrode capacitive desalination (FTE-CD) technology. This advanced technology removes salt from water by applying an electric field to two porous electrodes. The electrodes act like a magnet for salt while the field is applied and remove the salt from water that flows through the electrodes using less energy and less costly than reverse osmosis (RO). Energy use of an FTD-CD system is projected to be 50% less compared to the energy use for an RO system. The recipient is partnering with two water districts to test the use of FTE-CD devices to desalinate wastewater and determine how this small, flexible device can improve the energy and operating efficiency of wastewater treatment solutions for communities. Wastewater from the industrial and municipal sectors will be used to test the technology along with measuring energy use and performance, such as fouling and other operation issues.

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

The FTE-CD technology has the potential of reducing the cost and energy use associated with desalinating water with low to moderate salt content and will represent an advancement over current RO technology. This can increase the potential to increase water recycling and reuse at the community or industrial level, which could reduce the need to procure and transport fresh water sources. Also, this advanced FTE-CD

technology is small and flexible which means that it can be customized to the scale needed for each community or industry, thereby increasing a community's water reuse potential which can increase drought resilience for the state.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: By reducing the cost of desalination by 30% or more, the cost of water reuse may become attractive compared to the cost of purchasing water and disposing of waste water.

Environmental Benefits: By reducing the cost of desalination by 30% or more, the cost of water reuse may become attractive compared to the cost of purchasing water and disposing of waste water. An increase in reuse means that less potable water overall is used, which increases drought resilience.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$448,176

EPIC Funds Encumbered:

$999,040

EPIC Funds Spent:

$875,000

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

27 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 6

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Recipient developed and tested a new operation mode of electrodes (called batch mode) and cell modules before deployment to Delta Diablo. Preliminary testing shows the potential to meet salt removal and productivity targets while reducing flow efficiency losses caused by undesired mixing of desalted water and feed water. Using the optimized electrodes, recipient demonstrated the ability to achieve desalination targets of 500 ppm tds removal with >70% water recovery using Delta Diablo water samples. Recipient also evaluated a novel charging circuitry design that takes advantage of the large inherent capacity of the cells to eliminate the need for AC-DC converters, thus simplifying the design and lowering cost.

Project Name: EPC-16-015 - Los Angeles Regional Energy Innovation Cluster

Recipient/Contractor: Los Angeles Cleantech Incubator

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/17/2016 to 3/31/2022

Program Area and Strategic Objective:

Market Facilitation

S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

The Los Angeles region lacks the necessary coordination of technical, business, and social support services for clean energy researchers and entrepreneurs to develop clean energy innovations and the business opportunities resulting from them. This lack of organizational support prevents the Los Angeles region from clearly understanding the best direction for its clean energy economy. A coordinated effort is needed to determine regional energy needs, foster the size and strength of its current clean energy ecosystem, and provide a full, curated range of technical and commercialization services that are currently not available for clean energy entrepreneurs.

Project Description:

This project establishes the Los Angeles Regional Energy Innovation Cluster to act as a regional hub of the clean energy ecosystem and to give promising clean energy entrepreneurs in Los Angeles, Orange, Santa Barbara, and Ventura counties direct access to the region's top technical, business, outreach, and commercialization support services. This project assesses and addresses the region's energy needs by making use of and expanding resources for entrepreneurs and startups, including facilities, coaching, business support, speaking and networking engagements, and information about funding opportunities, all through connections facilitated by the Los Angeles Cleantech Incubator.

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

This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. This project will also support technologies based on the regional energy market needs and engage a diverse group of clean energy stakeholders to provide the support, network, and resources needed for accelerated clean energy commercialization.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 2a, 3e

Lower Costs: This project will reduce the time and cost of new energy technology development by providing entrepreneurs with access to facilities, resources, and services needed to commercialize their innovation.

Economic Development: The services provided by this cluster will support the development of local companies and job creation, and further develop the clean energy economy throughout the Los Angeles region.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$541,645

EPIC Funds Encumbered:

$4,999,247

EPIC Funds Spent:

$1,130,999

Match Partner and Funding Split:

Los Angeles Cleantech Incubator: $165,290 (1.9 %)

Los Angeles County Office of Sustainability: $2,104,712 (24.3 %)

Southern California Edison: $300,000 (3.5 %)

California State Polytechnic University Pomona: $24,625 (0.3 %)

CSU Dominguez Hills: $24,625 (0.3 %)

California State University, Long Beach Research Foundation: $24,625 (0.3 %)

CSU Los Angeles: $24,625 (0.3 %)

CSU Water Resources and Policy Initiatives: $5,000 (0.1 %)

California State University, Northridge: $24,625 (0.3 %)

Sustain Southern California: $597,998 (6.9 %)

CSU Channel Islands: $49,500 (0.6 %)

LA Business Technology Center: $99,000 (1.1 %)

Los Angeles Cleantech Incubator: $99,000 (1.1 %)

Economic Development Corporation of Los Angeles County: $99,000 (1.1 %)

Community Environmental Council: $15,474 (0.2 %)

Match Funding:

$3,658,099

Leverage Contributors:

U.S. Department of Energy: $600,000

Leveraged Funds:

$600,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

2 out of 2 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2018, the LA Regional Energy Innovation Cluster accepted its third cohort of portfolio companies to receive services, for a total of twenty-six startups who have engaged with this program to date. The program will continue to provide important technical and business services such as speaking and networking opportunities, access to business development resources, awareness of funding opportunities, and connections to local energy stakeholders. The program also recently off-boarded startups from its first cohort. The program helped these startups meet critical milestones, including advancement in technology readiness, expanded customer base and partnerships, increased staff, and follow-on funding. As of June 2018, startups receiving services from this program have received $9,376,000 in private follow-on funding and $1,348,000 in public follow-on funding.

Project Name: EPC-16-016 - Commercializing a Disruptively Low Cost Solar Collector

Recipient/Contractor: Hyperlight Energy

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 10/14/2016 to 3/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Concentrated Solar Power (CSP) is a promising form of renewable energy that has been hampered by high solar collector costs and high power block costs. In addition, there is need to enable use of geothermal power plant turbines that are underutilized due to resource decline at many sites in California.

Project Description:

This project has developed a low cost Concentrated Solar Power (CSP) collector to advance the market readiness of this technology. Hyperlight's CSP collector is based on the linear Fresnel reflector (LFR) and is able to make cost reductions through breakthroughs in materials, design, manufacturing, and installation. A major innovation of the system involves use of mirrors attached to UV stabilized and low-cost plastic tubes that are mounted on a sealed water bed foundation. The project has developed: (1) a single 1,000 square foot module used for lifecycle testing and validation of upgraded design elements; (2) a one-half acre system for pilot testing and demonstration; and (3) a front end engineering design study to establish the feasibility and requirements to scale the system up to ten acres and to co-locate with other renewable energy such as a geothermal facility. EPIC funds are being used as cost share funding to Hyperlight's $1.5 million grant from the US DOE.

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

The project will support technological development by advancing a low-cost CSP collector to commercial availability. In addition to the value of demonstrating the collector through the physical installation, the front end design study and the availability of this low cost collector could inform geothermal power plant owners on the potential to use this innovative system to boost the output of their plants and provide more renewable energy to the grid. The resulting increase in heat transfer fluid temperature from 200 to 300 C expands the market for this technology from food processing to biofuel process plants and petroleum refining.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

Applicable Metrics: CPUC Metrics- 2a, 4a

Lower Costs: This project will develop solar collectors that are roughly half the cost of current collectors, reducing overall system costs for concentrated solar to $99/m2 compared to existing cost of $200/m2. The LCOE from this technology is expected to be 6 cents per kWh compared to current state of the art CSP cost of more than 20 cents per kWh. The increased efficiency from 30 percent to 50 percent will help in reducing the solar field costs as well as land impacts of CSP.

Environmental Benefits: This project will generate 3,500 mmbtu of heat per year, resulting in 50 tons of CO2 offset annually.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$177,896

EPIC Funds Encumbered:

$750,000

EPIC Funds Spent:

$747,342

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $1,500,000

Combined Power, LLC, dba Hyperlight Energy: $752,694

Leveraged Funds:

$2,252,694

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

System and method of generating energy from solar radiation.

Update:

A prototype reflector of 20 feet by 50 feet was tested to 10,000 cycles representing a 30-year lifetime, and results of the testing showed minimal degradation. The pilot system has been operating as designed. Total system annual solar-to-thermal efficiency of 1/2 acre module plant was in the range of 60% to 85%. An important milestone achieved in this project is the mass manufacture and installation of the tube structural components required to achieve cost-savings. This project was completed in March 2019. Hyperlight energy will design and install this technology, at Saputo Cheese plant in Tulare to convert solar energy into supplemental heat for thermal processes required to process milk into cheese. In addition, this technology has a good chance of utilization to boost output of geothermal plants.

Project Name: EPC-16-017 - Maximizing Energy Efficiency and Reducing Bio-solids Waste from New Anaerobic Wastewater Treatment Technology

Recipient/Contractor: Silicon Valley Clean Water

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 11/10/2016 to 3/1/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Based on 100-year--old technology, wastewater treatment has consumed abundant water, energy, and land, and fails to capture the significant energy resource value of wastewater. The result are systems that: 1) are energy-intensive, consuming 3 percent of electricity nationwide and generating significant amounts of greenhouse gas emissions, 2) produce large quantities of biosolids with high energy, greenhouse gas emissions, and monetary disposal costs, 3) neglect the value of wastewater as a reliable local water supply, nutrient resource, and energy supply, and 4) are at the end of their design life.

Project Description:

This project is demonstrating the elimination of aeration and its high energy demands as part of secondary water treatment at the Silicon Valley Clean Water wastewater treatment facility using a novel staged Anaerobic Fluidized Bed Membrane Bioreactor (SAF-MBR). This System is projected to generate 30 percent less bio-solids than conventional systems that require aeration. This project also seeks to demonstrate the potential for development of a new high quality local water supply through non-potable and advanced potable reuse treatment trains that eliminate process steps that normally precede the use of reverse osmosis.

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

This project has the potential to lower energy costs of wastewater treatment and water recycling. The advanced technology used in this project is the Staged Anaerobic Fluidized Bed Membrane Reactor (SAFBMR), which eliminates the aeration stage of wastewater treatment. The aeration stage is one of the most energy intensive steps in wastewater treatment. The SAFBMR also has the potential to reduce operation and maintenance costs because bio-solids waste, which typically requires off-site disposal, is reduced, and the effluent does not require the typical microfiltration pre-treatment step prior to the reverse osmosis systems.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

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

Lower Costs: The technology has the potential to lower facility operating costs due to the removal of the aeration step from processing wastewater, the reduction of bio-solids that must be disposed, and the increased yield of methane biogas - a potential fuel source for on-site energy generation. The recipient estimates that a 1 million gallon per day treatment facility could achieve annual electricity savings of up to $185,000 from both efficiency and renewable energy generation over a 20 year life cycle. In addition, the technology is also estimated to result in 10 percent lower cost in capital and operation and maintenance cost compared to existing processes.

Environmental Benefits: The lower energy use along with onsite renewable energy production will reduce greenhouse gas emissions. This project also will reduce biosolids waste that is typically trucked for off-site disposal. Additionally, the project will also produce higher quality water for potential potable uses.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$327,386

EPIC Funds Encumbered:

$1,999,962

EPIC Funds Spent:

$288,685

Match Partner and Funding Split:

Leland Stanford Junior University: $400,000 (12.4 %)

Santa Clara Valley Water District: $100,000 (3.1 %)

GE Water: $210,000 (6.5 %)

LG Water Solutions: $10,000 (0.3 %)

Silicon Valley Clean Water: $499,943 (15.5 %)

Match Funding:

$1,219,943

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

8 out of 8 bidders

Rank of Selected Applicant/ Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The Research Team has finalized and submitted the Benchmark Report characterizing the performance and costs of existing systems used to treat wastewater for water reclamation and reuse. The design of the Staged Anaerobic Fluidized Bed Membrane Bioreactor has been completed. The contractor was chosen to construct the project at Silicon Valley Clean Water in May 2019. Installation is expected to be completed in 2020. A Technical Advisory Committee meeting and a wastewater workshop were hosted by the CEC in November.

Project Name: EPC-16-018 - Biological Double-Efficiency Process as an Advanced Wastewater Treatment Method to Achieve Substantial Energy and Water Savings

Recipient/Contractor: BDP Technologies

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 11/21/2016 to 4/1/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

The most common secondary wastewater treatment process for nutrient removal is the activated sludge process. Most activated sludge processes are energy and land/space intensive as they include separated anoxic and aerobic tanks with secondary clarifiers. The infrastructure requires high capital, land footprint, and embedded energy and operation and maintenance costs. The current challenge for wastewater treatment plants in California is to meet the demand from population growth, increasingly stringent regulations and aging infrastructure while potentially reducing the energy and water consumption.

Project Description:

This project is demonstrating an efficiency technology that targets one of the major energy using steps in wastewater treatment. The Biological Double Efficiency Process (BDP) combines state of the art, easy to maintain aeration technology, airlift circulation/dilution technology, and an integrated all-in-one bioreactor technology to replace the separate anoxic and aerobic tanks associated with secondary clarifiers. The BDP is based on simultaneous nitrification/denitrification principles.

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

The innovative BDP technology has the potential to provide substantial energy savings to wastewater treatment plants, including reducing 50 percent of the aeration required for secondary treatment, thus decreasing electrical energy requirements and greatly improves oxygen transfer efficiency to 48-52 percent compared to 20-30 percent in conventional technologies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: The BDP technology could reduce energy and water consumption and costs at wastewater treatment plants while also meeting California's growing water and wastewater needs. In addition, the BDP technology could provide advantages of reduced energy and land use, carbon footprint (CO2 emissions), waste sludge generation, and operation and maintenance costs. The technology has the potential benefits of substantial 50 percent energy reduction, 30 percent less capital, 50 percent less land required, 50 percent reduction in operation and maintenance costs, and water savings opportunities.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$15,486

EPIC Funds Encumbered:

$1,565,400

EPIC Funds Spent:

$1,027,068

Match Partner and Funding Split:

BDP Technologies: $330,904 (17.4 %)

Match Funding:

$330,904

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

8 out of 8 bidders

Rank of Selected Applicant/ Bidder:

Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Welding of remaining support beams was completed and installation of electrical equipment continues. After conclusion of welding, the job site was also cleared of construction debris. Coordination between BDP and the project contractor continues to arrange and plan for personnel and equipment installation. In preparation for plant startup and operation, BDP is coordinating with subcontractor, Veolia, to start planning for daily schedules and operation routines for the operator.

Project Name: EPC-16-019 - 21st Century Solutions for 20th Century Wind Projects

Recipient/Contractor: The Regents of the University of California on behalf of the Davis campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 2/13/2017 to 5/30/2019

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

California has a large number of aged wind turbines. According to the American Wind Energy Association project database, there are approximately 4,500 sub-300 kW turbines operating in California with rudimentary control systems. Those old turbines lack remote communication and control systems and cannot be remotely dispatched on and off. During periods without wind, the turbines remain online and energized, drawing grid power at high retail rates and costing owners up to $100,000 per year.

Project Description:

This project aimed to develop inexpensive, standardized turbine upgrades that will allow aged turbines to behave more similarly to modern turbines by dispatching on/off when it is beneficial. The upgrade was a low-cost, robust, wireless communication and control system. The project included installation of wireless communications and a field demonstration of the turbine upgrades and the forecasting algorithm at an operating wind plant in collaboration with CAISO and wind plant owners. The team conducted a field test at a wind farm in the Tehachapi region.

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

The innovative, real-time dispatch system for legacy turbines and implementation of a low-cost, robust form of remote communication and control developed under this agreement addressed the inability to efficiently and quickly on and off dispatch turbines when grid and market conditions demand. The project delivered a low cost standardized communication and control system for aged turbines capable of remote on/off dispatch, and created a grid, market, and weather forecasting system to enable automated dispatching of turbines in response to oversupply and low/no wind conditions.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

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

Lower Costs: The project implements low-cost and reliable over-the-air remote communications and control for legacy wind turbines. The systems developed under this project reduced costs of communication and control systems for legacy turbines by 82 percent compared to existing systems. The turbine controller is composed of a radio module with a cost of $42/unit, interface electronics costing $300 per unit, antenna and cable totaling $10, and free software. This significant reduction in cost of control systems and increase in data quality enables increased use of such control systems in legacy turbines.

Greater Reliability: The upgrades implemented in this project will increase grid reliability and limit needed grid adjustments by enabling dispatchability of legacy turbines. The forecasting algorithm of negative pricing events developed under this project saved $351.43 per MWh and forecasted 89 percent of negative pricing events.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$322,793

EPIC Funds Encumbered:

$810,438

EPIC Funds Spent:

$672,149

Match Partner and Funding Split:

Department of Mechanical and Aerospace Engineering - UC Davis: $124,916 (13.4 %)

Match Funding:

$124,916

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 32 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

DNV GL's Forecaster weather modeling and short term power prediction tools and software will be used to support creation of a model that can identify optimum periods for dispatching aged turbines on & off. The dispatch algorithm developed for this project will utilize Forecaster inputs, but could be operated with forecasts from other systems.

Update:

Through development of the innovative, real-time dispatch system for legacy turbines and implementation of a low-cost, robust form of remote communication and control, this project addressed a key technical barrier for legacy wind plants to efficiently and quickly dispatch turbines on or off as grid and market conditions demand. The economic analysis found that a properly-sized energy storage system has the potential to reduce peak loads and associated demand charges, with a payback period of three to four years. The remote dispatch system and forecast algorithm demonstrated successful operation during a three-month field test involving nine turbines at a wind plant in Tehachapi, California and the cost of the prototype control system was reduced by 82% compared to the cost of a similar commercial system. Information on the remote dispatch system and forecast algorithm are open-source.

Project Name: EPC-16-020 - Recovery of Lithium from Geothermal Brines

Recipient/Contractor: SRI International

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 1/16/2017 to 8/12/2019

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

Expansion of geothermal energy production in California will greatly benefit from the creation of a value stream produced by the recovery of useful metals from geothermal fluids. The efficient separation of metals, such as lithium, from geothermal brines promises to make the production of geothermal power more economically favorable. Revenue will be produced from the sale of the marketable metals, and the scaling and re-injection issues associated with the high-solid-content brines will be minimized.

Project Description:

This project demonstrated a cost-effective integrated process for the recovery of lithium from geothermal brines based on: (1) new high-capacity selective composite sorbents comprised of inorganic lithium-ion sieves and lithium-ion-imprinted polymers; and (2) a new sorbent regeneration process using eco-friendly carbon dioxide/carbonic acid that leads to the direct formation of high-purity lithium carbonate (Li2CO3). Compared to traditional methods of Li recovery from brines, the high-capacity selective sorbents and their regeneration process are expected to lower the cost of Li production by enabling online separation with higher recovery efficiency, using smaller volumes of sorbents, and minimizing processing time. The project demonstrated a laboratory-scale integrated separation process for the production of high-purity Li2CO3 from geothermal brines.

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

This project will lead to technological advancement by enabling co-production of power and high-value metals from geothermal resources. The co-production of metals will improve the economic viability of geothermal power production, therefore increasing the penetration of geothermal renewable energy.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 2a, 3g

Lower Costs: The technology developed by the project will lower the cost of geothermal power production as a result of the recovery of useful metals from geothermal fluids. There is a total of about 400 MWe produced by the 11 power plants operating in the Salton Sea Known Geothermal Resource Area. Based on the price of $12,000 per ton of lithium carbonate, the economic value of the lithium that could be produced by existing Salton Sea power plants is estimated at over $1.3 billion per year. This is higher than the economic value of the 400 MWe produced by the 11 power plants.

Economic Development: According to a 2008 feasibility study sponsored by the Imperial Irrigation District, developing geothermal resources could result in creation of some 7,000 to 9,000 jobs, many of which would likely be higher paying than typical jobs in the county. A number of these jobs are likely to be in communities to the north, east, and south of the Salton Sea -- areas that meet the CalEnviroScreen designation as disadvantaged communities.

Environmental Benefits: Additional geothermal energy sources in the Salton Sea Known Geothermal Resource Area will reduce air pollution, which may improve the health of people in affected zones. Revenue from the land leases and mineral recovery is expected to support Salton Sea restoration projects, which some sources estimate may cost on the order of $3 to $9 billion.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$452,445

EPIC Funds Encumbered:

$873,387

EPIC Funds Spent:

$873,387

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

29 out of 32 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project successfully demonstrated the laboratory-scale Integrated Lithium Capture System. The recipient has licensed the technology to ExSorbtion, Inc. who will be pursuing commercialization.

Project Name: EPC-16-021 - High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 2/13/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

In operating geothermal fields, there is a need for imaging the movement of water and steam in three-dimensional space and over time. Tracer tests provide ground truth information about inter-well connectively, but they do not directly reveal the flow paths in the regions between the wells. Microseismicity mapped in three-dimensions can provide valuable information about fluid movement, but it is possible for water and steam to move through the fractured rock mass without triggering microseismicity, as well as for microseismicity to be triggered without fluids.

Project Description:

This project advances the current state for imaging subsurface flow paths, barriers, and heterogeneity in operating geothermal reservoirs through an integrated approach that combines the recent development of low-cost, dense seismic networks together with established state-of-the-art micro-earthquake imaging algorithms and rock physics concepts. The technical advancement of this project is the integration of these components into a system that can be cost-effectively, reliably and routinely deployed in operating geothermal fields to image the movement of fluids in space and time with high-resolution and fast-turnaround time from data collection, to processing, to imaging, to rock physics interpretations.

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

This project will provide tools to help geothermal operations to be more productive. It will demonstrate the advantages of a micro-earthquake imaging system that uses a dense network of seismic stations and automated processing to perform fast-turnaround, high-resolution imaging of fluid movement in producing geothermal reservoirs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 2a, 3a, 3b

Lower Costs: A better understanding of the subsurface flow paths will allow optimization of production activities and improve well targeting to drill more productive wells. Drilling wells with a 5-10% efficiency increase (whether in steam production or water injection wells) is a reasonable assumption with improved well targeting. At a 10% efficiency increase, 1 well in 10 could be eliminated from the drilling program while maintaining production levels. The Geysers well drilling program generally includes, at minimum, the equivalent of 10 deep wells and 5 shallow wells in 5 years. Deep wells cost approximately $6,500,000, while shallow wells cost approximately $3,000,000 to drill.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$528,896

EPIC Funds Encumbered:

$1,672,639

EPIC Funds Spent:

$1,260,000

Match Partner and Funding Split:

Jarpe Data Solutions: $50,000 (2.9 %)

Match Funding:

$50,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 32 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project team completed the processing of seismic data from initial hypocenter locations. The team completed creation of a finite difference benchmark dataset for use in validation of hypocenter location accuracy. It also conducted joint tomography for 3D velocity structure and hypocenter locations for a 17,000+ event dataset. While the one-year data acquisition campaign was completed in June 2019, the 91-station network remains in place for future operations and, time permitting, for additional data collection and tomographic imaging.

Project Name: EPC-16-022 - Comprehensive Physical-Chemical Modeling to Reduce Risks and Costs of Flexible Geothermal Energy Production

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 2/13/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

The increased use of intermittent renewable energy (primarily wind and solar) increases the inherent variability and uncertainty in electricity generation and resource availability, and thus drives the need for operational flexibility of other renewables such as geothermal energy. Converting production from baseload to flexible production may result in significant changes to the system related to corrosion and mineral deposition (scaling) in wells and mechanical fatigue damage to well components or the reservoir. A better understanding of the impacts of flexible-mode production on the reservoir-wellbore system is needed to ensure safe and sustainable production.

Project Description:

This project seeks to address the specific challenges of base-load and flexible-mode geothermal production, including wellbore and reservoir integrity, scaling, and corrosion. An improved model is being developed and applied to better understand these issues. Flexible mode production typically includes daily cycles in production rate that result in extraordinary stress on the wellbore and reservoir system. The modeling and assessment is being conducted to predict short- and long-term impacts of flexible-mode production on liquid-dominant geothermal reservoir systems representative in California as well as on the site-specific vapor-dominated Geysers Geothermal Field.

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

This project will lead to technological advancement by providing modeling tools that can be used by geothermal operators to better understand the impacts of flexible-mode production on the reservoir-wellbore system. This knowledge will allow the development of power plant and control technologies to enable geothermal power plants to operate in different variable modes, and to be both a base-load and flexible renewable resource.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 (closed) Long-Term Procurement Proceeding (LTPP): R.13-12-010 (closed)

Applicable Metrics: CPUC Metrics- 2a, 3a, 5a, 5f

Greater Reliability: Switching base-load production to flexible-model production for an existing geothermal power plant will allow for increased use of intermittent renewable resources. The installed capacity of geothermal power plants in California is sufficiently large to have a significant impact on electricity reliability.

Increase Safety: The project will quantify effects of flexible-mode production on the well integrity, including corrosion and potential mechanical well failure. This leads to increased confidence on how to safely operate in a flexible production mode.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$480,995

EPIC Funds Encumbered:

$999,032

EPIC Funds Spent:

$660,000

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

29 out of 32 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The modeling tools have been completed. The project completed modeling simulations for base-load and flexible production for liquid dominant geothermal systems. The project team has modeling the Geysers using pilot test data and is in the process of acquiring data from other geothermal systems to model as well.

Project Name: EPC-16-024 - San Gabriel Valley Water Company "Plug and Play" In-Conduit Hydropower Development Project (SGVWC Project)

Recipient/Contractor: San Gabriel Valley Water Company

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 3/1/2017 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Typically, the 100 kW or less pressure-reducing valves are located in above- or below-ground structures that were not designed for the addition of in-conduit hydroelectric systems. To adapt a water-to-wire system at these sites, resources are spent designing a custom powerhouse to include civil, mechanical, and electrical systems. However, sub 100-kW sites often share characteristics that present an opportunity to integrate a standardized (plug and play;) powerhouse design for in-conduit hydroelectric systems.

Project Description:

The San Gabriel Plug and Play; In-Conduit Hydropower Development Project aims to design, develop and demonstrate a modular, cost-effective in-conduit hydroelectric system designed for the sub-100-kW in-conduit hydroelectric market that will reduce civil, mechanical, electrical, and interconnection costs. The San Gabriel Project includes a new 73 kW modular plug and play; in-conduit hydroelectric station at a space-constrained site in an urban, potable water system that will provide an estimated 381 megawatt-hours (MWh) of renewable generation per year, while also providing a model that can be deployed to many undeveloped, small sub-100 kW in-conduit sites throughout the state.

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

The project will recover wasted energy from an existing pressure-reducing station. The recipient estimates there to be about 120 similar-sized pressure reducing opportunities within California, representing 9,000 kilowatts that will become economically viable if the project is able to meet its cost reduction goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

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

Lower Costs: This project is expected to benefit investor-owned utility electricity ratepayers by reducing the cost of sub-100 kilowatt hydropower by an estimated 20 percent.

Environmental Benefits: Over the course of its 30-year asset life, the 73 kilowatt hydropower project is expected to reduce CO2e emissions by 8040 metric tons.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$13,082

EPIC Funds Encumbered:

$500,000

EPIC Funds Spent:

$449,989

Match Partner and Funding Split:

San Gabriel Valley Water Company: $612,000 (47.7 %)

NLine Energy, Inc.: $170,000 (13.3 %)

Match Funding:

$782,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

29 out of 32 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project completed December 2019. To ensure that San Gabriel Valley Water Company can meet peak water demand in the summer time, construction began in the fall of 2018 and the system was commissioned in the summer of 2019. Testing and operation activities were conducted and will be included in the final report.

Project Name: EPC-16-025 - Comprehensive Assessment, Tools and Resources for Advancing In-Conduit Hydropower in California

Recipient/Contractor: Stantec Consulting Services Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 2/13/2017 to 10/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

The development of in-conduit hydrogeneration continues to lag behind the available potential. Informational barriers contribute to this limited development, including lack of publicly-available information on site selection, equipment selection, commissioning, operation, and testing.

Project Description:

This project conducted a comprehensive assessment of in-conduit hydropower generation potential in California and developed a guidebook and a business case assessment tool that assist municipal, agricultural, and industrial water purveyors with the cost effective implementation of in-conduit hydropower generation projects. The proposed guidebook and the business case assessment tool will provide invaluable knowledge base for municipal (water and wastewater), agricultural and industrial agencies that are considering capturing hydrokinetic/hydrostatic energy and integrating in-conduit hydropower into the existing energy mix. The Business Case Assessment Tool will assist users with building a business case for implementation of an in-conduit hydropower project, providing qualitative and quantitative guidance on the system configuration and site characteristics for fit-for-purpose applications, and estimating preliminary life cycle cost, LCOE, and GHG emissions.

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

Newer in-conduit hydroelectric turbine technology research and development has not been adequately covered in any published guidebook. Available guidebooks do not include many novel technologies and lack technical information related to performance, equipment, siting criteria, engineering design considerations, and costs that will assist California's stakeholders in determining which in-conduit hydroelectric technologies are best suited for a particular site.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

Applicable Metrics: CPUC Metrics- 1a, 3a, 3b

Lower Costs: The development of a clear, concise and transparent guidebook for assessment of in-conduit hydropower in California will enable electricity ratepayers to benefit from effective deployment and avoid the risk of failed projects. Developing the tools for evaluating the economic and environmental impacts of in-conduit hydropower generation will help ensure that projects are cost-effective and reduce costs for California ratepayers.

Greater Reliability: Deployment of in-conduit hydropower could provide a source of capacity and renewable energy that contributes to resource diversity and electrical system reliability. California has the potential to install 414 MW of in-conduit hydropower across 450 different locations.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$121,338

EPIC Funds Encumbered:

$400,000

EPIC Funds Spent:

$399,998

Match Partner and Funding Split:

Stantec Consulting Services Inc.: $35,372 (7.3 %)

NLine Energy, Inc.: $19,104 (4.0 %)

Leland Stanford Junior University: $28,542 (5.9 %)

Match Funding:

$83,018

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

29 out of 32 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team estimated the in-conduit hydropower potential in California by analyzing data collected by NLine Energy, results from a questionnaire prepared by the team and distributed to various water agencies, as well as crossing data from USGS, DWR and SWRCB database. The estimate concluded that while there is at-least 343 MW of installed in-conduit hydropower facilities in California as of 2017, there is 414 MW of remaining potential. The team also conducted eight case studies, which identified that small in-conduit hydropower projects should consider multiple scenarios at the feasibility stage to investigate different hydrologic conditions, and interconnection costs can vary considerably. The final report and assessment tool were presented in a webinar attended by more than 200 people.

Project Name: EPC-16-026 - Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/15/2017 to 12/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

During periods of peak electrical usage, matching supply and demand for the electric power grid has become increasingly challenging due to increasing penetration of variable renewables into the supply mix. Demand response (DR) provides an opportunity to mitigate grid instability and the high cost of purchasing electricity at critical times. California's industrial sector has the potential to provide fast and flexible DR through the development of control strategies.

Project Description:

This project develops and pilot tests integrated control strategies for demand response (DR) at two demonstration sites in California: a water pumping station and an industrial refrigerated warehouse. Both test sites have built-in energy storage capabilities. The pumping station stores energy in water pumped uphill, while the refrigerated warehouse stores energy as thermal mass in frozen food. The capacity for storage allows for temporary shed, shift or adjustment in power demand. The proposed technology will integrate controls, energy cost, historic load data, and tariff information to allow for optimized demand response. These control strategies are expected to be practical and technically feasible.

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

This project develops technology that will enable industrial customers to provide automated DR service to the grid including fast ramping, operating reserves, frequency regulation, and peak load reduction in support of California's goals for DR and energy efficiency as well as renewable integration and greenhouse gas emissions reduction.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1g

Lower Costs: The project has the potential to reduce demand for a variety of grid use cases including fast ramping, operating reserves, frequency regulation, and peak load reduction. This can result in lower demand charges and energy costs to the customer.

Greater Reliability: Supporting fast and flexible demand response helps to augment power system reliability and results in less stress on the grid by reducing peak loads. These services can help with maintaining system reliability.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$888,920

EPIC Funds Encumbered:

$3,000,000

EPIC Funds Spent:

$798,335

Match Partner and Funding Split:

Southern California Edison: $300,000 (8.7 %)

San Diego Gas & Electric Company: $15,000 (0.4 %)

Electric Power Research Institute, Inc.: $150,000 (4.3 %)

Match Funding:

$465,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 2: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Both the water and refrigeration projects will shortly start data collection. The collection of water pumping data was delayed because the water agency, CalWater, needed to approve the software platform for data transfer and collection. The recipient is now on track to collect data through fall 2020. The refrigeration project was delayed because of a site change from a refrigerated warehouse in Long Beach to Mira Loma. Currently, the recipient is on track to collect data and conduct demand response analysis for the fall/early winter 2020 period. The recipient continues to evaluate the controls capabilities based on the load profiles for both the refrigeration and water facilities.

Project Name: EPC-16-027 - Facilitating On-farm Participation in Energy Demand Management Programs

Recipient/Contractor: Irrigation for the Future, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/3/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Irrigated agriculture represents a significant source of energy-use and peak demand in California. California's level of irrigation management is advanced relative to the rest of the country, with 40% of irrigators using some form of scientific irrigation management when deciding when to irrigate. To reduce energy and water use further, partial irrigation timing strategies, such as deficit irrigation, are needed. Partial irrigation strategies can reduce energy use or shift demand times while maintaining or increasing farm profits, but these benefits are not well documented.

Project Description:

This project develops a management tool for optimizing irrigation at 10 farms in California. The sites have varied water requirements, growing a mix of almonds and alfalfa. The project is validating a pre-commercial water management system that allows irrigators to have more flexibility over when they irrigate and use energy. Instead of adding water whenever the soil is dry, this system will manage plant stress so that water can be delivered when costs are low and when needed by the plant. The purpose of the management technology is to enable irrigators to participate in utility incentive programs offering benefits to customers who can shift their energy demand. This management approach would enable participation in utility demand response, time of use, and automated demand response programs.

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

The project results in testing an irrigation management system to facilitate use of partial irrigation strategies, enabling flexible energy load control. This will allow irrigators to participate in utility demand response and time of use programs while providing flexibility to the grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 1b, 1e, 1f, 1g, 2a, 4c

Lower Costs: This project could lower energy costs and demand through participation in utility incentive programs for time-of-use, demand response, and automated demand response. It could also reduce water use and cost by 15% per farm.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$153,035

EPIC Funds Encumbered:

$1,588,872

EPIC Funds Spent:

$868,986

Match Partner and Funding Split:

Irrigation for the Future, Inc.: $126,663 (7.4 %)

Match Funding:

$126,663

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant/ Bidder:

Phase 1 Group 2: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The intellectual property contains copyrights to "Irrigation Management Online."

Update:

The research team continues to collect in-season measurement and observations at the cooperating farms in preparation for the third season field trial of the automated irrigation management system, Irrigation Management Online (IMO). This system employs automated data integration that can generate updated irrigation schedules which is sent to the grower on-demand via the updated IMO interface. The IMO system informs the growers of the water use and yield reduction consequences of participating in any particular DR or Auto DR event.

Project Name: EPC-16-028 - Irvine Ranch Water District Load Shifting and Demand Response Pilot Project

Recipient/Contractor: Advanced Microgrid Solutions, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/7/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Water agencies operate within strict health, safety, and reliability and ratemaking constraints. Participation in demand response programs is not part of the core mission of water agencies and funding to increase demand response participation is not supported in the rate design. Electricity tariffs for water agencies intended to reduce peak demand are often at odds with the operating requirements of water and wastewater treatment facilities. Smart load control and demand response technologies are needed to automatically reduce peak demand, usage, and optimize cost, within existing tariffs and operational constraints of water agencies.

Project Description:

This project develops, tests, and validates a load-shifting optimization platform to reduce energy use and demand charges in the water sector. The platform advances pre-commercial demand response technologies to reduce: peak demand, energy use, and operational costs. The platform integrates advanced real-time monitoring, automated load shifting control, energy storage, and a pre-commercial cost optimization platform. Data generated by the project will validate the approach and identify best practices for increasing water sector participation in demand response programs.

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

The project integrates several pre-commercial and commercial technologies into a platform that enables operational equipment and energy storage resources to respond automatically to energy price signals. The integrated approach promotes greater participation in demand reduction events, including the ability to participate without prior-day notice.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011

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

Lower Costs: The project is estimated to reduce on-peak demand by 22 percent, or 650 kW; reduce energy usage 32 percent, or 267 MWh of electricity; and save $326,000 annually in reduced energy costs. The target market for this technology are the estimated 1,300 retail water and wastewater pumping, treatment, and storage facilities throughout California. If all eligible facilities statewide install the technology, the result would be 80 MW of reduced demand.

Greater Reliability: The project will validate the ability of water agencies to participate in demand response events on an automated basis, enable a more rapid response, and allow for greater load reduction. This project has the potential to increase grid reliability by increasing participation in demand response programs and providing dispatchable load reduction.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$832,615

EPIC Funds Encumbered:

$1,403,465

EPIC Funds Spent:

$479,453

Match Partner and Funding Split:

Advanced Microgrid Solutions, Inc.: $760,427 (35.1 %)

Match Funding:

$760,427

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team has conducted energy audits of the pilot sites, modeled facility load profiles, and assessed which tariffs are most advantageous for reducing peak demand and energy. The largest pilot sites are on new tariffs that allow participation in the local capacity resource program. Design, engineering and installation of battery storage systems at six sites is complete. Opportunities for load control at the 11 sites have been developed and tariff analysis incorporated to quantify the impact of battery storage and operational load control with eligible demand response programs. The project team has reviewed the potential opportunities with the Irvine Ranch Water District. The water district is currently considering which operational load control measures to implement.

Project Name: EPC-16-029 - Water/Energy Bank Proof-of-Concept

Recipient/Contractor: Antelope Valley Water Storage, LLC

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/13/2017 to 7/31/2019

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The State Water Project (SWP) which transports water annually from the northern part of the state southward is California's largest user of electricity - about 2% of the State's anticipated 2020 peak demand. A significant portion of the electricity is used to pump water over the Tehachapi Mountains which involves a nearly 3000-foot lift in elevation. The issue is whether SWP contractors can be incentivized to shift their water delivery schedules to non-summer months to optimize energy benefits and whether there can be a guaranteed peak load reduction in the summer months when electric grid demand is at its highest levels.

Project Description:

This proof of concept study evaluated the feasibility of using groundwater storage and cycling surface reservoirs to shift the State Water Project's Southern California water deliveries to non-summer months to reduce summer electric grid peak demand. Shifting the timing of water deliveries could reduce solar and wind power over-generation risk during non-summer months when renewable energy is in surplus. This project investigated the technical, institutional, legal and economic feasibility of implementing a guaranteed water delivery shift and develop demand response and load shifting tools and strategies to manage peak load and demand and thereby reduce energy costs in the water sector.

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

The project could lower peak demand on the electric grid during summer months when power demand is at its highest levels. This will increase the reliability of the electric grid system, reduce the use of peaker plants that operate on fossil fuels to meet system demand and operating margins, and lower Department of Water Resource's water transport costs by shifting electric demand to non-summer months when demand and energy rates are lower.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011

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

Lower Costs: By implementing the recommendations found by this research study, the State Water Project (SWP) contractors could eliminate the need to meet peak electricity needs using fossil-fueled combustion turbines due to summer reductions of State Water Project pumping. Department of Water Resources costs to import water could also be reduced by using the lower rates for electricity available during non-summer months. Ratepayers would benefit from lower peak demand prices due to reduced grid load during peak periods.

Greater Reliability: Implementing recommendations from the research study could improve electric grid reliability by providing a guaranteed summer pumping reduction that provides firm demand response to match the evening ramp up as solar arrays go offline. It is independent of natural gas availability - the fuel for the State's newer combined cycle power plants and higher polluting peaker plants. The water energy bank is a demand response resource that can address a grid emergency such as the loss of generation or transmission facilities to improve reliability.

Environmental Benefits: Implementing the recommendations from this study has the potential to increase use of renewable energy generation during periods of over generation by pumping water through the State Water Project during these times. Use of renewable energy generation results in less use of fossil fueled combustion turbines to meet summer peaks.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$150,000

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$824,854

Match Partner and Funding Split:

Antelope Valley Water Storage, LLC: $225,000 (18.4 %)

Match Funding:

$225,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project was completed in July 2019. The technical and final reports are complete. Using the Edmonston pumping plant for the analysis, implementation of the Recipient's recommendations would lead to an average peak load reduction of 60 MW from July to September based on a normal water year. A notable finding is the possibility of converting the Water-Energy Bank into an energy neutral operation through the use of 40 MW of solar arrays and 5 MW of hydropower. The Recipient presented the Water-Energy Bank concept at the Demand Response & Distributed Energy Resources World Forum on October 16, 2018 and American Water Works Association CA-NV spring conference The Recipient also plans to publish results in journals and disseminate results at future conferences after the end of the grant period.

Project Name: EPC-16-030 - Enabling Energy Efficient Data Centers in Smart Power Distribution Systems

Recipient/Contractor: The Regents of the University of California, on behalf of the Riverside Campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/8/2017 to 12/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Data centers consume an estimated 2% (100 billion kWh) of total U.S. electricity with a cost of around $10 billion. The peak demand of data centers represents over 2% of peak load in California and is expected to grow 4% annually in the next ten years. Therefore, it is critical to develop energy efficiency technologies for data centers in California.

Project Description:

This project is researching and testing technologies that improve data center energy efficiency at three different levels in a smart power distribution system. The technologies include increasing server energy efficiency, through coordinated deep sleep and dynamic voltage-frequency scaling (DVFS); data center workload balancing through phase and load balancing across multiple servers in a data center; and geographical workload balancing through phase/load balancing in a single or multiple power distribution network or feeder.

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

Data centers are a major consumer of electricity. In the PG&E service territory, peak demand of data centers is around 500 MW, representing 2.5% of peak load consumption. The energy use from data centers is expected to increase by 4% annually in the next 5-10 years. The development of agile energy efficiency solutions for data centers is needed. This project provides unique software based solutions, rather than hardware solutions, to reduce electricity consumption by data centers through deep sleep and dynamic voltage frequency scaling, peak efficiency scheduling and spatial workload scheduling. If successful, potential electricity savings of up to 35% could result.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1g, 2a

Lower Costs: Much of the technology being developed by this project is software based that has the potential to lower data center processing energy usage and the costs associated with it. The recipient estimates that implementation of three proposed techniques could annually save data center operators over 1,000 GWh, resulting in estimated cost savings of $173 million if implemented at a 100%.

Environmental Benefits: If the three proposed techniques are implemented, and saves data operators over 1,000 GWh annually it can result in a reduction of 365,863 metric tons of CO2, if implemented at 100%.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$306,631

EPIC Funds Encumbered:

$1,783,118

EPIC Funds Spent:

$633,262

Match Partner and Funding Split:

The Regents of the University of California (UC Riverside): $265,567 (12.8 %)

San Jose State Research Foundation: $31,497 (1.5 %)

Match Funding:

$297,064

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team has completed the modeling of the Peak Efficiency Scheduling Algorithm and have preliminary average results of approximately 15% overall energy usage reduction. The project team is now working on development of the load migration and the demand response algorithms. Early examples show nearly perfect compliance. They can effectively move their demand within milliseconds. They accomplish this by starting with a base load then adding dummy loads to match artificially demand requests.

Project Name: EPC-16-031 - VOLTTRON Testing Tool Kit

Recipient/Contractor: SLAC National Accelerator Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 3/31/2017 to 3/29/2019

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

California's energy goals include high levels of utility-scale renewables and distributed energy resources (DER). These goals can be achieved only if the distribution utility can operate the grid reliably while supporting ever larger amounts of DER. Today's DER management and system integration projects are either not integrated with each other or are costly to implement, as it requires highly skilled labor to connect specialized equipment and program software to optimize system operation. As buildings and operations change, specialized software must be adjusted, tested, recalibrated for optimal use and performance.

Project Description:

This federal cost share project demonstrates the benefits of the VOLTTRON platform for DER management through the testing of the VOLTTRON Testing Tool Kit. VOLTTRON is a US Department of Energy funded open source platform intended to provide a software base for integrating management of energy demand in buildings, distributed energy resources, and the electrical grid. The tool kit includes simulation test suites, a platform monitoring and debugging tool, and more extensive database support to promote wider adoption of VOLTTRON platform beyond its original set of developers. By lowering implementation costs and adding easy adoption features, the tool kit encourages adoption by other users, including organizations and private entities seeking to develop DER integration projects.

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

Communication of DERs with grid operators is critical for successful utilization of distributed energy resources. DOE developed the VOLTTRON platform to facilitate such communication. However, the platform is in its early stages and requires additional support and an expanded user base to become widely adopted. The VOLTTRON Testing Tool Kit provides new tools to confidently run a high qualify open source project. All knowledge gained and software written will be pushed to GitHub for open source use. With the testing tool kit, VOLTTRON becomes a more effective platform for DER

management. This will enable higher utilization of DERs in support of the state's renewable energy and GHG reduction goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1d, 1e, 1f, 1g, 1h, 4a, 5b

Lower Costs: By lowering implementation costs and adding easy adoption features, the tool kit encourages adoption by other users, including organizations and private entities seeking to develop DER integration projects. The new capabilities added through this grant should speed up any development efforts since all tools developed are open source and available through the GitHub.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$28,501

EPIC Funds Encumbered:

$70,000

EPIC Funds Spent:

$70,000

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $700,000

Kisensum: $105,000

Leveraged Funds:

$805,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project objective was to facilitate adoption and demonstrate the benefits of the VOLTTON platform for DER management systems. The project team set out to increase the VOLTTRON user community and increase its diversity in order to move VOLTTRON closer to reaching a critical mass needed for widespread market adoption. The project team created awareness among the DER industry and utilities through the project and added several new companies that engaged with the VOLTTON. The project team found that the DER industry is further along in their integration effort and switching to VOLTTON could cost them significant effort and time. However, the new capabilities added with this project should help speed up the newcomers' development efforts should they chose to utilize VOLTRTRON. All tools developed contributed back to the VOLTTRON open source repository on GitHub.

Project Name: EPC-16-032 - Leading in Los Angeles: Demonstrating Scalable Emerging Energy Efficient Technologies for Integrated Facade, Lighting and Plug Loads

Recipient/Contractor: New Buildings Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

The Los Angeles basin is in drastic need of energy and carbon reductions in the wake of the Aliso Canyon natural gas leaks. Deep building energy retrofits can realize large energy and carbon savings in existing buildings. However, barriers such as cost-effectiveness, unknown savings potential, and scalability have limited implementation of large scale building retrofits that would provide a significant impact.

Project Description:

The recipient is demonstrating and validating new retrofit package solutions from laboratory pre-testing through field demonstrations in existing government-owned commercial buildings. The solution sets, dubbed "INTER", are comprised of shading products from Rollease Acmeda and lighting and plug load systems and integrated controls, including HVAC systems, from Enlighted. The technologies can be combined and customized to suit a variety of building types and spaces, resulting in an estimated whole building energy reduction of 20 to 32 percent. Beginning in the Los Angeles basin, the team is leveraging existing market connections to increase and accelerate market adoption of these retrofit solution sets to maximize the potential energy and carbon savings, first in the region and ultimately, throughout California.

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

This project creates a holistic, low-barrier integrated retrofit solution for significant energy savings. The scalable energy retrofit solution will be demonstrated in municipal government buildings but is also applicable to other commercial and residential buildings and to new construction and existing buildings. Installation does not require specialized training. The integration of technologies can produce higher savings than individual technologies operated in isolation. Creating building retrofit solutions that are least disruptive to building occupants while solving energy, occupant and owner issues are key

to providing solutions that will support California's statewide zero net energy and existing building goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: The project could reduce annual energy use in a typical large office building by 32 percent. The lighting control system is demand response capable. If this suite of technologies is implemented statewide in existing buildings over the next 15 years, estimated savings include 2,692 GWh $421 million, and 639,000 metric tons of CO2e, assuming a retrofit rate of just 3 percent annually.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,767,847

EPIC Funds Encumbered:

$4,981,000

EPIC Funds Spent:

$3,491,017

Match Partner and Funding Split:

Rollease Acmeda, Inc.: $670,000 (10.0 %)

Delos: $25,500 (0.4 %)

Enlighted Inc.: $190,000 (2.8 %)

Southern California Edison: $150,000 (2.2 %)

Lawrence Berkeley National Laboratory: $50,000 (0.7 %)

CSU Dominguez Hills: $200,000 (3.0 %)

BeMO USA Corp: $110,000 (1.6 %)

City of Santa Ana: $30,000 (0.4 %)

Daintree: $300,000 (4.5 %)

Match Funding:

$1,725,500

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 8 out of 10 bidders

Rank of Selected Applicant/ Bidder:

Phase 1 Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the recipient completed testing at FLEXLAB of an integrated suite retrofits for commercial buildings, including shading products from Rollease Acmeda and lighting and plug load systems and controls from Enlighted and produced a testing report that included measurement plan and test results. The test results covered summer, fall and winter. The integrated retrofits resulted in savings of 62% in the winter and 76% in the summer, relative to the existing building baseline. HVAC load savings were found in the cooling mode and were similar to the lighting energy savings. The project was discussed at the 2019 Behavior, Energy and Climate Change Conference. The team completed installations of the integrated retrofits in buildings located in the city of Santa Ana and CSU Dominguez Hills. The project was discussed at the 2019 Behavior, Energy and Climate Change Conference.

Project Name: EPC-16-033 - Internet of Things and Ubiquitous Sensing in University Building Energy Management: Design Optimization and Technology Demonstration

Recipient/Contractor: CSU Long Beach Research Foundation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/30/2017 to 9/20/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

A research gap exists in the number of demonstrations and pilots, including market awareness and education that can address building owners resistance to taking on new technologies or upgrades for existing buildings. Even though new energy management technologies can reduce energy use and operating costs, there is reluctance to try new state-of -the art technologies.

Project Description:

This project develops and evaluates a pre-commercial energy management system at a building on the CSU Long Beach campus. The research uses energy efficient technologies with internet of things (IoT) controls in order to optimize load operation, load leveling, and peak shaving. IoT solutions can provide more granular data to better target technology and efficiency solutions. The advancements in monitoring and controls from this project will enable deployment of similar systems at other academic facilities in California.

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

The project aims to remove barriers to achieve widespread deployment of state-of-the-art energy management technologies. The project provides California IOUs, academic institutions (universities, including 22 CSU campuses), energy management technology developers, and other stakeholders with an IOT-based energy management platform. Additionally, the project provides a comprehensive example of the potential for large scale deployment, including technical considerations, building performance, energy savings, and non-energy benefits.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1g, 1h

Lower Costs: The use of IOT-based controls is projected to reduce on-peak energy demand of HVAC by 100 kW and the peak demand of lighting and plug loads can be reduced by 125 kW. The total annual electricity and thermal savings are estimated at 570,000 kWh and 1,600 therms or approximately $163,000 annually.

Environmental Benefits: Reduction in on-peak energy demand and electricity consumption could reduce the need to burn fossil fuels for electricity generation and result in an estimated 137 metric tons of CO2e reduced. Being able to shift electric loads anytime during DR events provides flexibility to the electric grid and the potential for increase renewable energy use during periods of over-generation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$78,271

EPIC Funds Encumbered:

$2,509,946

EPIC Funds Spent:

$739,630

Match Partner and Funding Split:

Enlighted Inc.: $411,500 (11.5 %)

ControlWorks, Inc.: $88,500 (2.5 %)

Regents of the University of California, Riverside Campus: $163,400 (4.6 %)

CSU Long Beach Research Foundation: $409,558 (11.4 %)

Match Funding:

$1,072,958

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 8 out of 10 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Amendment was approved and awaiting execution. CSULB has completed the installation of the IoT-based measures, including sensors that enable the energy management system to control new LED lighting, and existing plug loads, and HVAC. The HVAC controls were installed in September 2019 and the team continues to collect data from the HVAC system as well as the IoT EMS system to evaluate the consumption and energy efficiency of the building post-IoT measure installation.

Project Name: EPC-16-034 - Automated Cloud-Based Continuously Optimizing Building Energy Management System

Recipient/Contractor: Zero Net Energy Alliance, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/1/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Current building energy management systems (BEMS) are typically programmed and set to a predefined schedule to ensure set points are reached. However, most BEMS fail to optimize energy use because predetermined settings become rapidly obsolete. In addition, energy management systems do not detect when buildings and energy systems degrade over time, creating "drift" in the months and years following commissioning. Even state-of-the-art BEMS require regular reprogramming to achieve and sustain a high degree of energy efficiency.

Project Description:

This project develops a software platform that helps building energy management systems run more effectively. The Automated Cloud-based Continuously Optimizing Building Energy Management System (ACCO-BEMS) automates and optimizes control of building systems and devices. It is being implemented at Pomona College in 11 buildings on campus, half of which will have ACCO-BEMS as a new building energy management system, the other half will have ACCO-BEMS integrated with the existing system.

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

Energy performance monitoring and fault detection diagnostics software is a key technology that must be further enhanced and deployed to overcome barriers to achieving ZNE buildings. A principal barrier to real-time management of energy systems is the many, often incompatible, protocols and interfaces used by energy devices and sensors. These have long represented a barrier to the integration of discrete systems, sensors and actuators necessary to automatically assess and control energy use. This project uses an internet-of-things gateway to communicate with the various energy using devices in the building using their native protocol and interface. The platform uses machine learning to assess real-time building performance and automatically adjust individual devices. The technology eliminates building drift and negates the need for expensive reprogramming or optimization measures.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The project has the potential to reduce electric demand and enable real-time automated demand response (ADR). The technology is being demonstrated at two Southern California college campuses and is estimated to enable 1 MW of ADR with projected annual energy savings of 1,600 MWh or $250,000 per year. The target market for this technology is educational, non-grocery retail and office buildings--which represents 43% of the total statewide electric use. Once scaled, statewide annual savings potential is estimated to be 7,269 GWh or an estimated $1.1 billion statewide.

Consumer Appeal: The technology can co-exist with existing systems or can be implemented as a new installation. For retrofits, ACCO-BEMS can connect to existing energy management systems, sensors, controllers, and meters to communicate with each in its native protocol. This allows for use of the technology with existing, installed equipment, avoiding the need for equipment replacement retrofits, or for the customer to learn a new system.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$552,488

EPIC Funds Encumbered:

$2,500,000

EPIC Funds Spent:

$1,921,915

Match Partner and Funding Split:

Zero Net Energy (ZNE) Alliance: $25,000 (0.7 %)

MelRok, LLC: $1,159,891 (31.5 %)

Match Funding:

$1,184,891

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 8 out of 10 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The ACCO BEMS platform is installed at 10 buildings on the Pomona College campus. The HVAC systems have been commissioned and additional sensors and actuators installed. The platform is running fault detection on sensors, actuators and command controls to identify abnormal data streams and detect failures in ventilation equipment, chillers, cooling towers, boilers, pumps and terminal units. Of the approximately 4,000 sensors and actuators evaluated, more than 100 data streams have been positively identified as indicative of problems at the sensor, actuator, or logic level. The fault detection engines use a combination of physics-based rules, and artificial intelligence (AI) based patter recognition to detect failures. The ACCO BEMS platform has successfully identified a number of problems and retrofitting opportunities that would have required costly manual recommissioning to uncover.

Project Name: EPC-16-035 - High-Performance Cu-Plating for Heterojunction Silicon Cells, Based on Ultra-Low-Cost Printed Circuit Board (PCB) Technology (Stage II)

Recipient/Contractor: Sunpreme, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/12/2017 to 12/31/2019

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Standard front side metallization of industrial silicon solar cells uses silver paste for contact formation. Silver metal contained in the paste is an important cost driver in the manufacturing process. At the same time, the conductivity of printed and fired silver metallization is limited due to glass compounds and a porous structure. A metallization scheme based on all-copper plating proposed under this agreement has the potential to lower these costs while improving the overall efficiency of the photovoltaic cells.

Project Description:

This project develops a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing, reducing costs by up to 35%, and increasing cell efficiency by 15%.

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

The project is developing a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing. This new process will lower electricity-related greenhouse gas (GHG) emissions and improve solar cell efficiency.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

Applicable Metrics: CPUC Metrics- 1b, 1c, 2a, 3b, 4a

Lower Costs: If successful, the production tools and processes developed under this agreement will allow for the manufacture of heterojunction silicon cells at 24% efficiency and 400 W panels at a cost of 40¢ per watt.

Environmental Benefits: Lower costs for photovoltaic panels will support California's transition to renewable sources of energy and result in reduced greenhouse gas emissions.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$730,620

EPIC Funds Encumbered:

$2,430,000

EPIC Funds Spent:

$1,711,084

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $4,999,999

Sunpreme, Inc.: $4,540,310

Leveraged Funds:

$9,540,309

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Patents issued to Sunpreme, Inc.:

1) "Low-cost solar cells and methods for fabricating low cost substrates for solar cells"

2) "Low-cost multi-junction solar cells and methods for their production"

3) "Low-cost solar cells and methods for their production"

4) "Low-cost multi-junction solar cells and methods for their production"

Patent Application: "Flat tabbing solar panels".

Update:

This project was completed in 2019. The research team developed and tested next generation manufacturing at a pilot scale for copper patterning on silicon photovoltaic cells. This includes the following steps: dual-sided exposure for high-throughput wafer patterning, cell development, cell stripping, cell etching and lamination. The project team manufactured solar photovoltaic cells with 24.03% efficiency, performed in-house reliability testing, and received certification from an independent laboratory. Completion of the final project task of integrating the process into a large-scale PV cell factory was inhibited by a lack of additional investment.

Project Name: EPC-16-036 - Thermoelectric Generator Application and Pilot Test in a Geothermal Field

Recipient/Contractor: AltaRock Energy, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Growth of the geothermal industry has been limited by the need for large and costly power plants and large-scale infrastructure to produce geothermal electricity economically. Typically, a geothermal project cannot produce electricity economically at a scale less than 5 MW. If smaller geothermal power plants could be economical, this would open up more opportunities to add geothermal power to the mix of supply resources.

Project Description:

Thermoelectric Generator (TEG) technologies have the potential to produce geothermal electricity without as much infrastructure (turbines, steam piping, etc.), thus making small-scale production and geothermal-powered microgrids both practicable and affordable. Small (<5 MW) geothermal projects could provide consumers with the same distributed power flexibility provided by solar and wind production with the additional benefit of being a more reliable baseload source of electricity. TEG technologies can also allow geothermal heat to provide balancing and grid support. This project is scaling up a TEG from the watt-level in the lab to a 20 kW unit for demonstration in a geothermal reservoir.

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

This project will develop a means to expand use of low temperature and stranded geothermal resources by making small scale production both practicable and affordable.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 2a, 3b

Lower Costs: Many smaller geothermal resources are not currently able to be developed because it would not be economical to build a traditional, large geothermal power plant. Thermoelectric Generator technologies have the potential to help small-scale geothermal power generation to be more cost-effective by requiring less infrastructure and a streamlined set of mechanical equipment.

Greater Reliability: New baseload and flexible renewable generation technologies will improve the performance and reliability of the electrical grid. Geothermal thermoelectric generators will expand use of low temperature and stranded geothermal resources in the state which have not traditionally been used to produce electricity. The technology can supply peaking power and balancing of intermittent renewable resources at much lower cost than batteries.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$388,589

EPIC Funds Encumbered:

$1,280,000

EPIC Funds Spent:

$353,140

Match Partner and Funding Split:

Leland Stanford Junior University: $5,000 (0.4 %)

AltaRock Energy, Inc.: $113,095 (8.0 %)

Match Funding:

$118,095

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team deployed two small test units at the geothermal site as a test run. The lessons learned helped the team make improvements to the design and process. Next, the 20 kW unit will be built and deployed. Due to 6-9 months of project delays, the project team is working to expeditiously complete the remaining project implementation steps.

Project Name: EPC-16-037 - The Amador Water Agency In-Conduit Hydropower Development Project (AWA Project)

Recipient/Contractor: Amador Water Agency

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

One of the oldest turbine technologies in California is the Pelton turbine, designed for high-pressure conduit sites. There are an estimated 62 MW of installed Pelton turbines in California that are nearing the end of their in-service asset life and an estimated 8.2 MW of new small, in-conduit Pelton sites that remain undeveloped due to lack of efficiency and high costs. There is an immediate need to design, test, and demonstrate an improved and more efficient Pelton turbine runner in order to provide a viable retrofit solution for degrading sites and expand small hydropower deployment in new sites throughout California.

Project Description:

The goal of this project is to design, test, and demonstrate a 417 kW in-conduit Pelton turbine runner at an existing Pressure Reducing Station (PSR) site located in Ione, California. The project will demonstrate the ability to maximize the wasted energy captured at the station using an improved design of a higher-efficiency Pelton turbine runner specifically designed for small, in-conduit hydroelectric applications to contribute in the integration of in-conduit small hydropower into the existing state energy mix.

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

The system developed under this project will recover and maximize the capture of wasted energy in a Pressure Reducing Station (PRS); improve the efficiency, performance, and cost of the Pelton turbine technology to capture wasted energy; provide a viable retrofit solution for degrading sites; and help expand small hydropower deployment.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

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

Lower Costs: Water agencies throughout the state will have an opportunity to generate additional revenue and offset ever-increasing electricity costs associated with treating, distributing, and collecting water to help reduce costs to investor-owned utility ratepayers.

Greater Reliability: The project will help achieve greater electricity reliability by supporting the generation of 72,000 MWh over a 50-year asset life of distributed, baseload renewable power using rotating equipment.

Environmental Benefits: The ability to maximize and capture the wasted energy at the Pressure Reducing Station (PRS) to generate over 72,000 MWh of renewable power will offset 50,650 metric tons (MT) of CO2-equivalent over the 50-year useful asset life of the project.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$750,000

EPIC Funds Spent:

$596,652

Match Partner and Funding Split:

NLine Energy, Inc.: $108,334 (5.8 %)

Amador Water Agency: $1,006,666 (54.0 %)

Match Funding:

$1,115,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 32 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project completed the design phase and contracted with Gilkes to manufacture the turbine, which was delivered in the spring of 2019. AWA also procured a general contractor, Central Sierra Electric, to construct the project. Construction of civil works and improvements began in the fall of 2018. Installation of the turbine and balancing of the plant began in late spring of 2019 and continued into the fall of 2019. Commissioning and testing and will begin by March 2020 and the project will be completed by June 2020.

Project Name: EPC-16-038 - Use of Indoor Rearing for Head-Starting Desert Tortoises

Recipient/Contractor: The Regents of the University of California on behalf of the Davis campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/31/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Rapid development of utility-scale solar electricity generation facilities in the desert southwest has resulted in loss of habitat for special status species, such as the Mojave Desert tortoise. Current law and implemented policies require that negative impacts to protected species be minimized, or offset. Research is needed to evaluate the efficacy of head-starting as a mitigation tool for offsetting or minimizing impacts to the desert tortoise as well as aiding recovery of the species to streamline future permitting for renewable energy development.

Project Description:

The project conducts experimental releases of juvenile desert tortoises raised since 2011-2013 and new hatchlings in 2016-2017 to evaluate the trade-offs of head-start duration on post-release survival of desert tortoises. The project team is dividing new hatchlings into two cohorts, raising half of them exclusively outdoors and the other half under a combination of indoor/outdoor rearing, releasing them as 2 year olds, and comparing their post-release survival. Data on the growth and survival of animals in this study provides guidance on the minimum duration of outdoor head-starting and whether indoor head-starting should be pursued in future head-starting programs for desert tortoises. Ultimately, the results of the study can inform the extent to which head-starting both indoors and outdoors is a viable solution for mitigating localized impacts to tortoise populations affected by development for solar energy production facilities.

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

The research will be the first to evaluate the trade-offs in duration of head-starting on post-release survival in the eastern Mojave Desert where numerous solar production facilities have been recently constructed. Because longer head-start periods cost more, finding the optimal head-starting duration will help develop more cost-effective head-starting programs. The research will also evaluate indoor-head-starting. If the increase in

size also results in an increase in post-release survival compared to outdoor-reared animals, indoor head-starting could dramatically reduce the costs of rearing animals to releasable size and also increase production of head-starting facilities.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard Program: R.18-07-003

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

Lower Costs: This project will result in the ratepayer benefit of lower costs by making head-start mitigation more cost-effective, reducing obstacles to future renewable energy deployment. It is important to determine the best practice methods for head-starting juvenile tortoises, including reducing time spent in captivity and increasing survival in the wild after release. This will minimize mitigation costs for renewable energy developers, thus reducing the cost of energy to ratepayers.

Environmental Benefits: New scientific knowledge on minimum size required at release while improving survivorship, resource needs, and translocation practices will guide management in the future. Implementation of more effective mitigation practices may increase probability of de-listing the desert tortoise from the endangered species list in the future, making renewable energy development more feasible.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$106,461

EPIC Funds Encumbered:

$493,089

EPIC Funds Spent:

$248,205

Match Partner and Funding Split:

The Regents of the University of California, Davis Campus: $61,119 (11.0 %)

Match Funding:

$61,119

Leverage Contributors:

National Park Service: $200,000

Bureau of Land Management: $200,000

Leveraged Funds:

$400,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

14 out of 14 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team produced tortoise hatchlings in 2016 and 2017 and assigned them either to the indoor or outdoor experimental groups. The indoor group was raised indoors in their first year and then transitioned to outdoor pens for the second year of their head-starting. All captive tortoises were measured to track their growth rates in different treatments. In September 2018, the team released 78 juvenile tortoises and began post-release monitoring using radio telemetry; the remainder were released in fall 2019. The project team is collaborating closely with a complementary project (EPC-16-053), as well as with U.S. Fish and Wildlife Service and California Department of Fish and Wildlife to develop guidelines and recommendations about the mitigation and recovery strategy. The recipient was granted a no-cost term extension to allow additional monitoring through the summer of 2020.

Project Name: EPC-16-039 - A Life Cycle Assessment of the Environmental and Human Health Impacts of Emerging Energy Storage Technology Deployment

Recipient/Contractor: The Regents of the University of California, Irvine Campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/8/2017 to 8/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Scalable stationary energy storage is a critical component for facilitating the increased integration of renewable resources and meeting California's energy goals. However, the information about environmental and human health impacts of the emerging large-scale energy storage technologies, especially flow batteries, is largely incomplete. A better understanding of the potential issues associated with the life cycle supply chain will enable these technologies to be scaled to the capacity levels necessary for providing widespread grid services without creating negative externalities.

Project Description:

This project investigates whether flow batteries are a viable option for providing grid energy storage at the large scale, either in place of or alongside lithium-ion battery technology. The researchers are examining a life cycle-based characterization of the environmental impacts and resource usage associated with three chemistries of flow batteries (Vanadium Redox (V2O5), Zinc-Bromide (ZnBr), and Iron-Sodium (FeNa)). Specifically, they are investigating materials use, energy use, and toxic waste outputs of the life cycle phases of each flow battery type, including materials extraction, manufacturing, use, and disposal or recycling as applicable.

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

This project provides guidance for California policymakers and planning agencies for selecting emerging energy storage technologies that can facilitate the increased uptake of renewable resources and decarbonization of California's energy system, helping safeguard the environment and public health. This study is a first of its kind for flow battery technology and provides the knowledge base needed for flow batteries to be deployed in a safe and environmentally sensitive manner.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed) Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

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

Environmental Benefits: This project will provide information that can be used to avoid environmental and safety issues that could result from the scale-up of energy storage technologies.

Public Health: The project will characterize the human health impacts from different grid-scale energy storage technologies. If successful, the project will help avoid potential health and safety issues that could hinder the scale-up of new energy storage technologies.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$98,142

EPIC Funds Encumbered:

$600,000

EPIC Funds Spent:

$355,367

Match Partner and Funding Split:

The Regents of the University of California, Irvine: $186,219 (23.7 %)

Match Funding:

$186,219

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

14 out of 14 bidders

Rank of Selected Applicant / Bidder:

Group 5: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project is well underway. The research team compiled a database for material use, energy use, waste, emissions, and costs associated with three different flow battery chemistries, using the inventory data obtained from three flow battery manufacturing facilities (ESS, UET, Primus Power). Using the database, the research team analyzed environmental impact profiles of different flow battery types, taking into account their effect on and benefits for energy systems under scenarios of increasing renewable resource penetration. In addition, the research team evaluated air quality impacts, impacts on respiratory health, non-cancer toxicity and cancer-related toxicity for each flow battery type for populations in California and submitted reports to the CEC. Moving forward, the research team will perform business case studies for different types of flow batteries.

Project Name: EPC-16-040 - Assessing Cooling Tower PM2.5 and PM10 Emissions using Advanced Instrumentation, Plume Transects, and Plume Modeling

Recipient/Contractor: The Regents of the University of California, Davis Campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/15/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The majority of California power plants are located in areas designated as nonattainment for particulate matter less than 10 micrometers in diameter (PM10). The increasing demands and decreasing supply of naturally available freshwater throughout California results in state policies discouraging the use of freshwater in cooling towers for recently approved thermal power plants. Degraded waters contain higher concentrations of total dissolved solids (TDS) and thus higher calculated emissions that require the purchase of costly PM offsets. These increases in emissions are a significant burden for power plant developers and may discourage the use of degraded water sources for cooling.

Project Description:

This project measures PM2.5 and PM10 across the spray drift plume from two power plant cooling towers that use fresh water and brackish water. These measurements are used to develop and validate a model of power plant PM2.5 and PM10 emissions. The end result is a model that power plant operators can use to minimize the PM2.5 and PM10 emissions of brackish water use in cooling towers.

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

The research team is using plume measurements from fresh and brackish water cooling towers to develop a model of the droplet and particle size distribution changes in cooling tower plumes as a function of cooling water composition, meteorological conditions, and cooling tower operating parameters. The model will be based on first principles of chemistry and physics and will be validated using the measurement data. The model supports the use of brackish water instead of expensive fresh water, leading to decreased costs for electric utilities and ratepayers and freeing up more fresh water for use in homes, industry, and agriculture in California.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 2a, 3a, 4b, 4c

Lower Costs: This project decreases power plant operating costs by enabling the switch from fresh water to brackish water in cooling towers, saving money to the operators of the facilities, since brackish water is less expensive than fresh water.

Environmental Benefits: This project enables the use of brackish water in cooling towers in California, conserving valuable fresh water resources.

Public Health: The modeling work focuses on decreasing the concentration of PM2.5 and PM10 downwind of power plant cooling towers when brackish water is used for cooling, thereby improving air quality in these locations.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$108,004

EPIC Funds Encumbered:

$700,000

EPIC Funds Spent:

$341,793

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

14 out of 14 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team has completed the design of the instrument package for PM monitoring from cooling towers and has tested two power plants. Since both power plants have a similar amount of TDS in the circulating water, the team identified a third power plant with different TDS levels to test the different behaviors; the team is working with the power plant's operator to schedule the field test.

Project Name: EPC-16-041 - Benefits and Challenges in Deployment of Low GWP A3 Refrigerants in Residential and Commercial Cooling Equipment

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/8/2017 to 1/29/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

California has an aggressive target to phase down high global warming potential refrigerant greenhouse gas emissions by 40 percent by 2030 (SB 1383) from 2013 levels. This includes proposed regulations to ban refrigerants with a global warming potential (GWP) greater than 150 in non-residential refrigeration by 2022, and refrigerants with a GWP greater than 750 in commercial and residential air-conditioning by 2023. A3 refrigerants are a very low-GWP alternative, but in order to utilize them, some redesign and standards development are needed, as well as more well-developed installation, operation, and maintenance practices.

Project Description:

This project develops test procedures and conducts testing for alternative refrigerants to assess flammability and to characterize energy savings. The recipient will also develop a favorability index of end-use market segments and equipment types based on potential GHG savings and commercial adoption feasibility.

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

This project is evaluating alternative, low global warming potential (GWP) refrigerants that will also result in increased energy efficiency of cooling equipment. This project will identify current barriers and technical issues, and assess the potential for an expanded set of products, which could use low GWP A3 refrigerants. The recipient will (1) develop test procedures for alternative refrigerants for flammability and energy savings characterization and (2) develop a favorability index of end-use market segments and equipment types based on potential GHG savings impact and commercial feasibility and adoption. This can help equipment manufacturers with product development and adopt equipment with much lower lifetime GHG emissions. By transitioning to refrigerants with lower GWP, the state will see fewer GHG emissions from commercial and residential buildings over the next 10-30 years.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Environmental Benefits: Transitioning to lower-GWP refrigerants for all product types by 2030 and 2050 could reduce refrigerant emissions and greenhouse gas emissions down to an estimated 5 and 6 Mt CO2e, for the refrigeration and air conditioning sector, respectively.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$221,625

EPIC Funds Encumbered:

$500,000

EPIC Funds Spent:

$460,000

Match Partner and Funding Split:

Institute for Governance & Sustainable Development: $500,000 (50.0 %)

Match Funding:

$500,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

14 out of 14 bidders

Rank of Selected Applicant / Bidder:

Group 7: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has prepared test plans to analyze cost savings, energy savings, GHG reductions, and efficacy of the A3 alternatives. There was a change to replace self-contained commercial refrigeration equipment, as their research indicated that manufacturers were already moving towards this direction. Instead, they will research room or window air conditioning units. The recipient has started testing room air conditioning units as well as mini-split and packaged terminal air conditioning units. The team is also performing soft-optimization tests of room air conditioning units to determine unit-level efficiency and capacity. Testing results are expected in April 2020.Their modeling of flammable refrigerants were calibrated and show good agreement with test data. Project end date has been extended to January 29, 2021.

Project Name: EPC-16-042 - Low-Cost High-Reliability Thermoelectrics for Waste Heat Conversion

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Current commercially available thermoelectric materials can only operate reliably up to 250 degrees C in temperature and have a low efficiency (5 percent). Few materials that have been evaluated at higher temperature suffer from reliability issues due to use of lead and oxidation and sublimation problems. Silicon is abundant and stable at high temperature, though while thermoelectric devices made from Si hold much promise, bulk Si has a low figure-of-merit. One established strategy for increasing figure-of-merit is to employ nanostructuring to decrease thermal conductivity. Silicon nanowires represent a new, highly-scalable technology that overcomes the limitations of previous efforts.

Project Description:

This project is developing a cost-effective mid- to high-temperature range (400-800C) p-type thermoelectric material for waste heat recovery using silicon nanowire arrays. The intent is to surpass technologies implementing an organic Rankine cycle or similar processes by having low parasitic losses, compact structure, and ability to be modularized for a broad scale of distributed applications. To achieve the goal, the project will advance the state of the art in nanowire characterization; demonstrate an optimized process for the production of Si nanowire arrays and a process to produce a freestanding array of aligned nanowires; characterize the thermoelectric and mechanical properties of these arrays and single Si nanowire; optimize the fabrication of the Si nanowire arrays; and integrate these arrays into devices capable of heat-to-power conversion. The results of device performance will be used to evaluate the techno-economic impacts of this technology. Taken together, the project will move silicon nanowire technology's Technology Readiness Level (TRL) from 2 to a prototype technology demonstration in a relevant environment (TRL of 5).

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

This project will address principal barriers to the widespread application of current thermoelectric materials by providing a low-cost, reliable, affordable, and mass-producible technology that can be broadly applied to convert high-temperature heat that is currently wasted at the production and retail levels in California.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Combined heat and power: D.10-12-035., R.08-06-024. (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

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

Greater Reliability: This project will create a cost-effective Thermoelectric Waste Heat Recovery system that will reduce energy use in the industrial sector, thus benefitting California ratepayers by increasing electrical reliability and lowering electricity costs.

Economic Development: The total waste heat potential in California is 763 megawatts. Assuming a system cost of $1.5/watt and a 10 percent penetration, the estimated levelized cost of electricity is $0.015/kWh. Considering the value of renewable electricity generated and a 20 year asset life, the net present value at 10% penetration is estimated at $1.2 billion, with a payback period of just over one year.

Energy Security: Based on the assessment sponsored by Oak Ridge National Laboratory, the total potential net savings in electricity use per year from harvesting waste heat is about 0.022 quads for California. This is based on one-third of the theoretical maximum efficiency limit for heat engines (also known as the Carnot efficiency). Assuming an average source temperature of 800 F and a 10 percent efficiency for the silicone nanowire thermoelectric conversion system, the total potential for this technology is approximately 0.011 quads.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$440,167

EPIC Funds Encumbered:

$2,000,000

EPIC Funds Spent:

$1,062,500

Match Partner and Funding Split:

The Board of Trustees of the Leland Stanford Junior University: $516,502 (20.5 %)

Match Funding:

$516,502

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

LBNL made a subcontractor change, with Stanford University now responsible for manufacturing the thermoelectric nanofibers. An amendment to add Stanford as a major subcontractor and extend the project term to recover lost time was approved and research is currently underway. To date, individual Si nanowires have been produced and the thermal properties have been measured.

Project Name: EPC-16-043 - Cost-Effective and Climate Resilient In-Conduit Hydropower and Civil Works Innovation

Recipient/Contractor: Natel Energy

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/1/2017 to 3/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

A 2006 report issued by the CEC estimated approximately 120 MW of low-head small hydropower available in irrigation structures in California. Additionally, hydropower generation is controlled by the irrigation district's delivery schedules and generally suffers outside the irrigation season, greatly affecting the economics of hydropower for many of these opportunities. Innovative strategies to reduce costs through effective equipment or site design, standardization, or increasing the water flows can bring many projects into an attractive return on investment.

Project Description:

This project aims to scale in-canal hydropower retrofits by lowering project footprint and civil works costs. As most drop structures in irrigation canals have a consistent design, the goal is to design and implement a modular powerhouse and standard plant design that can be replicated across irrigation drops in California. Using a simple and more easily scalable design will support the installation of the system across the low-head sites identified across California with in-canal potential.

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

Greater reliability will be achieved by enabling greater penetration at significant total megawatts of new, distributed baseload renewable energy with predictable generation profiles. The project will also significantly reduce the capital cost of installing small hydropower in existing irrigation drop structures by reducing the cost of construction and civil works by an estimated 50 percent when compared with installing custom designed works and equipment for each site.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

Applicable Metrics: CPUC Metrics- 1a, 1b

Lower Costs: The over-canal design being pursued in this project is estimated to lower the LCOE of low-head hydropower at irrigation system drop structures to $55/MW by 2019, unlocking approximately 150 MW of baseload renewable capacity in the state.

Greater Reliability: The design enables simplified maintenance by minimizing part counts and directing machine wear to specific, easily-replaced parts. The design leads to straightforward and streamlined operation, minimizing scheduled maintenance and prolonging product operating life.

Increase Safety: Natel's California project pipeline is focused on low-head, low-pressure in-conduit or in-canal hydropower projects, auxiliary benefits from which include improving safety. At the bottom of a conventional high or low-head dam that utilizes a stream reach, a hydraulic jump zone similar to an undertow at a beach often develops, which increases drowning risks for project area communities, particularly children. Natel's design incorporates a draft chamber that is comparable to an enclosed stilling basin where any remaining force in the water is diffused and allows water to leave the chamber depowered, further reducing associated attractant flow risks for both humans and animals.

Economic Development: Distributed hydro is inherently local and thus contributes directly to local construction jobs and improving the financial position of local institutions like irrigation districts. Distributed hydro projects are often integrated into independent grids, the maintenance of which requires skilled technicians and thus also leads to job creation.

Public Health: Although the projects associated with this grant will interconnect to PG&E distribution systems, future projects have the potential for distributed hydro as an off-grid solution for remote communities. In remote locations where diesel generators are the primary or sole source of electricity, distributed hydro can reduce the usage of diesel generators and help improve air quality at a cost that is often well below that of diesel generation.

Energy Security: Energy security is enhanced by powering an otherwise unutilized hydrological resource in the form of an existing hydrological structure, reducing both present and future dependences on imported fuel sources. Distributed generating assets can also help reduce the impacts from natural (and man-made) disasters, as they complement and increase the overall resilience of the electricity grid.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$954,715

EPIC Funds Spent:

$96,816

Match Partner and Funding Split:

Natel Energy: $954,715 (50.0 %)

Match Funding:

$954,715

Leverage Contributors:

United States Department of Energy: $1,610,000

United States Department of Energy: $1,000,000

United States Department of Energy: $820,000

Leveraged Funds:

$3,430,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 32 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kicked-off in July 2017. The project team selected two sites for demonstration: Alder Drop in Yolo County, and Murphys Afterbay in Calaveras County. Interconnection applications for both projects were filed with PG&E. CEC staff was informed in early July 2019 that the economics of the project as currently structured are not viable. The project was placed under a stop work order while exploring options to deploy at an alternate site.

Project Name: EPC-16-044 - Hyper Efficient Pump Motor Unit with Fully Integrated Permanent Magnet Motor and Motor Controls with Combined Liquid Cooling

Recipient/Contractor: Terzo Power Systems, LLC.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/1/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

The greatest barrier to the adoption of current energy saving technology in hydraulic power systems is high cost and long break-even period. This barrier has not been addressed due to the research and development costs associated with integrating the newest, highest efficiency technology.

Project Description:

This project is developing an economical and efficient configuration for large scale integration and adoption of highly efficient liquid cooled permanent magnet motors, and fully integrated, liquid cooled motor controls. The goal is to use these technologies in the development of a smart pump motor unit that can quickly be commercialized and adopted statewide.

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

This project could reduce the operating cost for hydraulic power systems by integrating an efficient permanent magnet motor, efficient motor controller, and a combined liquid cooling loop. Hydraulic power systems are found in nearly all industrial facilities.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: Project will increase efficiency of hydraulic pump systems by up to 80% thereby reduce energy costs by an estimated $18,974,250 per year assuming 100% market penetration by 2025.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$99,350

EPIC Funds Encumbered:

$2,311,050

EPIC Funds Spent:

$2,056,775

Match Partner and Funding Split:

Terzo Power Systems, LLC.: $19,589 (0.8 %)

Ansync Labs, Inc.: $126,100 (5.1 %)

Match Funding:

$145,689

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has completed reports on the Insulated-Gate Bipolar Transistor (IGBT) and Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) efficiency. Other tasks completed include testing with the hydraulic manifold and finalized machining work for aluminum housing for eventual thermal, hydraulic and electrical testing.

Project Name: EPC-16-045 - Development of New Technologies for Agricultural Loads to Participate in Renewables Integration, RTP Programs, and/or New Time of Use Rates

Recipient/Contractor: Polaris Energy Services Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/1/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Participation in demand response (DR) programs by agricultural customers using irrigation pumps is largely limited to emergency/reliability programs. The potential for irrigation pumps to be managed for more frequent/regular response to dynamic DR programs appears high, but challenges remain that require additional research and demonstration. Research focusing on resolving these challenges and developing effective, replicable strategies--particularly coordinating control systems with crop and operational needs such as sand removal, reservoir charging, and crop response to variation in irrigation schedules--is needed.

Project Description:

This project develops a smart irrigation control system that improves and expands on current remote irrigation pump switching technology. The technologies developed will provide growers with the ability to automate their preferred load control strategies in response to new time-of-use electricity rates. Beyond that basic capability, the systems facilitate automated response to utility and system operator demand response signals, enabling participation in current and future demand response and reliability programs. The system is being deployed and tested on multiple farms and multiple crop types in PG&E service territory in the Fresno area.

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

For many electrical utilities, agriculture is a significant component of their peak load. Collectively there are between 160,000 and 170,000 irrigation pumps in the Central Valley. This project addresses the direct electricity cost of irrigation for agricultural customers and the indirect cost to all electricity ratepayers of procuring sufficient resources to meet marginal peak demand, integrating variable renewable energy generation, and building sufficient infrastructure to support agricultural pumping load peaks. The project goal is to develop control systems and operational strategies that can

adapt to different rate designs--including dynamic and DR-program tariffs--by optimizing pumping loads across large numbers of irrigation pumps to me

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed) Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1g, 1h, 3f

Lower Costs: The technology could facilitate effective response to time of use rates and facilitate participation in demand response programs through the shifting of agricultural irrigation pumping to lower cost time or in response to program incentives, lowering customer costs as well as enabling effective implementation of programs/tariffs designed to reduce system costs and meet state policy goals.

Greater Reliability: The technology could facilitate participation in demand response programs through the shifting of agricultural irrigation pumping to periods of surplus renewable energy, which improves system reliability by matching load to available supply and shedding loads during grid emergencies.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$415,408

EPIC Funds Encumbered:

$2,884,912

EPIC Funds Spent:

$2,073,453

Match Partner and Funding Split:

Polaris Energy Services Inc.: $649,485 (18.4 %)

Match Funding:

$649,485

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Michael Hardy, Control Dynamics, and Polaris developed the core hardware and associated firmware communications needed to remote control irrigation pumps remotely. The recipient intends to use this platform and methods to develop the new controller.

Update:

Progress this year includes completing hardware, software, and program development and deployment to start the transactive energy pilot, and analyzing initial results. Preliminary results indicate the ability of pilot test sites to effectively shift irrigation pumping loads (about 30 percent can be successfully shifted). The team has also engaged regulators, utilities, and industry to increase awareness of obstacles that prevent the agricultural sector from participating in demand flexibility markets and programs.

Project Name: EPC-16-046 - Pilot Testing of Isothermal Compression

Recipient/Contractor: Institute of Gas Technology dba Gas Technology Institute

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/12/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Currently, gas compression is limited by the thermodynamics of an adiabatic process which causes the gas being compressed to heat up during compression, making it harder to compress. This heating process can also lead to high operating temperatures which can increase the friction and wear of moving components. It is estimated that as much as 90% of the mechanical work input into an air compressor results in a loss of energy compared to the useful work output of the compressed air that is used to power an industrial process. Heat of compression is the biggest driver of this energy loss.

Project Description:

Gas Technology Institute (GTI) and Carnot Compression LLC (Carnot) are developing and field testing a novel, near isothermal air compressor which will enable improved efficiency, maintenance and reliability. The unit will be tested at an industrial facility in southern California. This project hopes to reduce the energy consumption in industrial, water, agricultural, and commercial applications that require compression of air and other gases. This project demonstrates a more efficient compressor that will use less electricity to meet the same performance metrics of existing air and gas compressors. If successful, this project could improve the energy efficiency of compressed air/gas systems which are prevalent in all industrial processing facilities.

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

This near isothermal compressor, or Carnot Compressor, solves the heat of compression problem by using a working liquid to compress a gas, while actively removing the heat of compression throughout the compression process. By removing the heat throughout the compression step, the energy required to compress air from near atmospheric pressure to ~100 psig can be reduced by up to 50% compared to commercial air compressors, such as piston, screw, and scroll designs. These energy savings are expected to significantly improve the efficiency of industrial air applications.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: The technology has the potential to reduce energy consumption from air and gas compressors by up to 50%. Once commercialized, the isothermal compression process will deliver significant energy efficiency gains across a broad spectrum of compression applications.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$628,022

EPIC Funds Encumbered:

$2,570,946

EPIC Funds Spent:

$1,861,364

Match Partner and Funding Split:

Carnot Compression LLC: $238,700 (8.5 %)

Match Funding:

$238,700

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team has validated all mechanical functioning and controls system operations. Work continues to fine-tune the system and make preparations for delivery of the prototype to GTI's Davis facility in March.

Project Name: EPC-16-047 - California Biopower Impact Project

Recipient/Contractor: Humboldt State University Sponsored Programs Foundation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/10/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Biomass is a potentially attractive energy resource that supports California's climate goals. However, there are significant gaps in existing life cycle assessment frameworks and methodologies regarding the climate impact associated with greenhouse gas (GHG) emissions from biomass use for electricity generation. Furthermore, biomass residue extraction has complex environmental and ecosystem impacts (positive and negative), some of which have not been well integrated into current life cycle assessments. Finally, there are significant market barriers to biomass mobilization in the forestry sector that need to be addressed in order for forest biomass utilization for energy to scale up.

Project Description:

This project develops an attributional life cycle assessment framework for various biomass-to-electricity supply chain and end-use scenarios that are specific to California. The research effort quantifies on a fine geospatial scale the amount of technically recoverable forest and agricultural biomass residue material in California, and it considers future impact projections from different climate change scenarios and fire risk probabilities under various harvest and land management scenarios. Based on the estimates, researchers are developing a detailed life cycle inventory - disaggregated by parcel, supply chain, and end-use characteristics. Results will support development of the California Residual Biomass-to-energy Carbon Accounting Tool (C-BREC) that will be made available to public and could inform policy decisions on the role of biomass residues in California's energy portfolio.

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

This research project develops a rigorous California-specific lifecycle emissions accounting framework for evaluation of various forest biomass residue mobilization scenarios, quantification of key potential environmental and climate impacts associated with biomass residue mobilization and conversion to electricity, and identification of potential pathways for offsetting biomass residue mobilization costs. The framework and Carbon Accounting Tool (CaRBCAT) will provide California policymakers with an evidence-based,

spatially-disaggregated, and probabilistic analysis to aid in creating policies aimed at managing the environmental performance of bioenergy systems. Ultimately, the results from this project will provide information on the topic of carbon neutrality of residual biomass-to-energy production.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012 Renewables Portfolio Standard Program: R.18-07-003

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

Lower Costs: Lower costs may be realized if the ecosystem service payments coupled with value estimates of potential carbon abatement from biopower exceed the internalized average or marginal wholesale cost per MWh of displaced generation.

Greater Reliability: Increased electricity reliability will be brought about by policies that encourage grid resilience through distributed generation facilities powered by biomass that would diversify California's mix of energy resources.

Environmental Benefits: The lifecycle assessment of biomass use for electricity generation will consider specific harvest practices, feedstock collection and handling practices, post-harvest treatments (briquetting, torrefaction, pelletization, etc.), feedstock management pathways, and conversion technologies, and it will provide information on the GHG implications from altered wildfire risk and severity and from altered long-term soil nutrient balance.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$247,784

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$559,284

Match Partner and Funding Split:

Sierra Institute for Community and Environment: $78,000 (6.9 %)

Humboldt State University Sponsored Programs Foundation: $53,575 (4.7 %)

Match Funding:

$131,575

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

14 out of 14 bidders

Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team has conducted a net potential recoverable forest and agricultural residue assessment and compiled a spatially explicit database of these materials. The team has also developed a residual biomass-to-energy life cycle emissions accounting framework that considers various supply-chain and end-use scenarios for California and published a beta version of an interactive accounting tool for GHG and criteria pollutants emissions accounting from woody biomass converted to electricity in 2019. Additionally, the research team continued working on the wildfire risk impact assessment, nearly completed characterization of secondary environmental and climate impacts from woody biomass, and started development of a document with policy considerations.

Project Name: EPC-16-048 - Development and Testing of an Energy Efficient Ultra-low Charge Ammonia Refrigeration System in a Food Processing Plant

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/5/2017 to 12/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Most ammonia-based cooling systems in use today require large amounts of ammonia and are prone to leakage from the mechanical shaft seal between the motor and compressor, and require special handling. Additionally, most ammonia systems used today are either water cooled or evaporative cooled, which require water, a very limited and precious resource in California due to recent droughts.

Project Description:

This project is pilot testing and demonstrating an air-cooled, low-charge ammonia refrigerant-based, integrated package closed cooling system for an industrial food processing application. The project is demonstrating the effectiveness of a water-saving innovation with the use of a micro-channel, air-cooled condenser. The project is demonstrating the expected energy savings of 20% compared to a chiller using hydrofluorocarbon (HFC) refrigerant for similar end use at the same site. This system eliminates the need for water for cooling. The entire system can be prepackaged and factory charged, and brought to site as an integrated package which simplifies field installation and makes it cost effective.

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

An air cooled, low-charge, ammonia refrigerant based integrated closed-packaged system with semi-hermetic motor/compressor seal that eliminates the mechanical seal between the compressor and the motor is not available in the U.S market today. As this is a packaged product, the M&V data from this project will help verify the energy savings and benefits and make it easier for customers to understand and implement this new technology and reap the energy and water savings benefits from it.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a

Lower Costs: Expected energy savings of 20% compared to a chiller using hydrofluorocarbon (HFC) refrigerant for similar end use at the same site. This system eliminates the need for water for cooling, which further adds to on-site cost savings.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$804,238

EPIC Funds Encumbered:

$2,406,054

EPIC Funds Spent:

$685,220

Match Partner and Funding Split:

TAKARA SAKE USA: $305,000 (10.1 %)

Electric Power Research Institute, Inc.: $300,000 (10.0 %)

Match Funding:

$605,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant/ Bidder:

Phase 1 Group 1: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has completed the low-charge, packaged ammonia chiller installation and is operating normally as confirmed by monitoring and verification (M&V) data. Preliminary M&V results show that the ammonia chiller is 38 % more efficient than the R-507A chiller. The Coefficient of Performance of the ammonia chiller is 4.87. The recipient is drafting the Technology Transfer Plan.

Project Name: EPC-16-049 - Ultra-High Power Density Roadway Piezoelectric Energy Harvesting System

Recipient/Contractor: University of California - Merced

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Heavy traffic of ground vehicles and pedestrians on highways, streets, and sidewalks provides considerable mechanical energy. There is an untapped opportunity to harvest the mechanical energy with under-pavement piezoelectric generators to exploit the large generation potential from traffic on the nation's highways and in major cities. This project aims to create a piezoelectric energy harvesting system with ultra-high density and efficiency.

Project Description:

This project leverages a multidisciplinary system approach to investigate the energy recovery potential of dual-mode piezoelectric generators to create roadway piezoelectric energy harvesting systems with ultra-high power density and efficiency. The goal is to design and test a piezoelectric roadway energy harvesting system, consisting of multi-layer stack generators and power electronics, to capture over 50% of the compression mechanical energy as electricity from passing vehicles. This project will demonstrate electric power generation, in the laboratory and on a 95 feet x 12 feet section of a road at the UC Merced campus, and will determine feasibility for future large-scale demonstrations on highways and streets with piezoelectric under-pavement.

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

This project advances a piezoelectric energy harvesting system with ultra-high density and efficiency. Using an award-winning piezoelectric technology with unique dual-mode and multi-layer generator design and under-pavement installation strategy for smooth drive of passing vehicles and pedestrians, this project will help the ratepayers in California by reducing cost of electricity and reducing emissions related to power generation.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1e, 3h, 4a

Lower Costs: At commercial scale, electric power density and cost are estimated to be 333 Watts per square foot and $9,010/kW respectively. The levelized cost of electricity is estimated to be less than $0.20/kWh.

Environmental Benefits: This project will reduce approximately 40 metric tonnes of CO2 equivalent. By retrofitting 1 percent of useable roadways, the environmental benefits will include reduction of CO2 emissions by more than 100 kilotons per year.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$310,100

EPIC Funds Encumbered:

$1,270,000

EPIC Funds Spent:

$125,133

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has completed design and fabrication of a batch of multi-layer piezoelectric generators and metal frame, and has conducted laboratory evaluation of the prototype. The prototype design was revised and improved, resulting in a promising relationship between the loading and displacement of the piezoelectric unit. An order to purchase 200 piezoelectric generator towers was issued and the project team has fabricated mechanical parts for 100 piezoelectric generators. A patent has been filed for the mechanical amplification design.

Project Name: EPC-16-050 - Scaling Reliable, Next-Generation Perovskite Solar Cell Modules

Recipient/Contractor: The Regents of the University of California, on behalf of the San Diego campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

There is need to deploy renewable energy to meet additional energy demand as well as replace fossil energy. Perovskite technology holds promise in dramatically reducing the cost of solar cell technology compared to silicon and thin-film solar cells, because these cells can be fabricated at low-temperature around 100°C. However, there is a need to address perovskite cell efficiency degradation, which may occur within hours of fabrication.

Project Description:

Recent advances have pushed the solar conversion efficiency, making perovskites one of the most efficient solar technologies in existence. This project will use a scalable large-area manufacturing approach for fabrication of the perovskite solar absorber, the solar cell's transport and contact layers, and the encapsulation of the solar cell modules. The project will also include bifacial module design, where light enters from both front and back.

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

Currently, encapsulated perovskite cells degrade in several hundred hours even in controlled low-oxygen and low-humidity conditions. This project integrates materials innovations developed to date at UC San Diego in the perovskite absorber layer, the solar cell's contact layers, and the encapsulation of the module to make breakthrough advances in perovskite solar cell reliability and scaling. Combining these materials together in a module assembly with glass on top and bottom slows degradation by a factor of 1,000. In addition, the bifacial design of the module boosts its efficiency.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4a

Lower Costs: This project aims to increase annual production of solar cells by reducing absorber and cell manufacturing costs relative to commercialized Si and thin-film technologies.

Greater Reliability: Integrating bifacial glass-glass modules should result in more energy production over time from solar cells and orders of magnitude improvement in perovskite solar cell durability, achieving at least 10 year operational lifetimes.

Economic Development: Over 75,000 people were employed in California's solar industry, installing over 3 GW of solar in 2015. The number of solar jobs would increase when next-generation perovskite modules are introduced at competitive costs to silicon modules.

Environmental Benefits: A 1% market penetration on IOU-territory rooftops will produce 1.36 TW-hr/yr of renewable energy. The value of the renewable energy produced annually is $235.8 million with 4.48 million metric tonnes CO2e avoided.

Public Health: In addition to avoiding greenhouse gas emissions, solar energy generation does not produce toxic air emissions including mercury, NOx, SOx and particulate matter that produce smog and are detrimental to health. A 1 GW deployment of the perovskite module technology would reduce emissions of NOx by at least 400 tons annually by displacing burning of natural gas.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$184,540

EPIC Funds Encumbered:

$1,450,000

EPIC Funds Spent:

$896,217

Match Partner and Funding Split:

The Regents of the University of California, San Diego: $146,050 (9.2 %)

Match Funding:

$146,050

Leverage Contributors:

National Science Foundation: $550,000

Leveraged Funds:

$550,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team successfully transferred graphene atop perovskite layers, developed new electron transport layers, and is improving cell process by characterization and new absorber layer chemistry. The project team is now comparing the unencapsulated perovskite against the graphene barrier layer encapsulated perovskite cells. The project is growing crystals by using an electro-deposition approach. The project has established an 80% yield on perovskite solar cells of 5 mm2 in size of at least 16% power conversion efficiency under one sun.

Project Name: EPC-16-051 - Increased Energy Efficiency via Programmable Irrigation and Fertigation

Recipient/Contractor: PowWow Energy, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/12/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Current energy efficiency programs do not address the complexity of farming, and in some cases conflict with each other at the farm. The lack of automation also slows the adoption of new irrigation and fertilization practices. An integrated approach to test cutting-edge technologies and demonstrating new irrigation strategies is necessary to provide additional energy and water savings without affecting crop yields. Geo-spatial and automated systems developed for the 3 commodity crops in the Midwest do not address the specific needs of California agriculture that grows over 350 specialty crops and produces more than 50% of the fruits, nuts and vegetables in the country.

Project Description:

PowWow Energy, in collaboration with WiseConn Engineering, West Hills College Coalinga (WHCC) and UC Santa Barbara (UCSB), is developing an automated, programmable irrigation management system that integrates cutting-edge technologies to increase the energy efficiency of irrigation (defined as using less energy to achieve the same level of crop production). Pilot-scale tests of the integrated technology platform will be conducted at two sites on commercial farms located in disadvantaged communities: an almond orchard near Delano (AgWise Enterprises, SCE territory) and a field with a rotation of row crops (tomato, garlic, etc.) near Huron (Woolf Farming and Processing, PG&E territory).

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

This project integrates three new strategies for water and energy efficiency on farms (continuous pump testing with automated remote pump control, programmable irrigation for specific soil types and plant varieties, and management of water and fertility) with PowWow's software. If successful, this project could help individual farms realize energy, water and cost savings without affecting crop yield or quality.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

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

Lower Costs: The project could lower energy and water costs by an estimated 25% annually while achieving optimum efficiency at each farm.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$341,285

EPIC Funds Encumbered:

$2,992,660

EPIC Funds Spent:

$1,769,894

Match Partner and Funding Split:

TBD Professional Services: $10,000 (0.2 %)

West Hills College Coalinga: $56,028 (1.7 %)

Environmental Studies Program & Bren School of Environmental Science & Management - UC Santa Barbara: $19,870 (0.6 %)

WiseConn Engineering: $7,000 (0.2 %)

Aduro Accounting & Consulting, LLC: $42,000 (1.3 %)

Mamala Research, LLC: $3,000 (0.1 %)

PowWow Energy, Inc.: $212,649 (6.4 %)

Match Funding:

$350,547

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 27 out of 28 bidders

Rank of Selected Applicant / Bidder:

Phase 1 Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Project team is working towards completing of Task 3 - which is the development of the soft for the programmable irrigation and fertigation so that work can begin on Task 4 which will be the integration of the software onto the mobile app to allow workers in the field to control pump system and implement precision irrigation and fertigation techniques.

Project Name: EPC-16-052 - Force Multiplier Actuated Piezoelectric Energy Harvester for Roadway Energy Recovery

Recipient/Contractor: Pyro-E, LLC

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Congested roadways present an opportunity for improving transportation and mobility. But the cost of new construction is expensive. An alternative approach is to leverage technology to make existing roads more energy sustainable and adaptable to real-time conditions. Regenerative devices, such as piezoelectric, have the ability to harvest energy from deflection, vibrations and applied mechanical stresses from overpassing vehicles.

Project Description:

The project develops, designs, and installs a multitude of pavement-embedded devices to demonstrate energy harvesting from overpassing motor vehicles on the road in smart pavement covering 36 feet x 6 feet. The system consists of materials that exhibit the piezoelectric effect, generating an electric charge.

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

The project demonstrates and assesses the potential of regenerative pavement technology, a roadway-embedded energy harvester that uses the untapped energy of car movements. The hardware devices developed using smart materials harvest energy from pavement deflections and vibrations under normal driving conditions. Energy performance data is collected to determine the technology's potential for widescale adoption in roadways and other surfaces.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1e, 2a

Economic Development: This project is expected to displace grid electricity with reduced rates, and will displace 9,550 kWh/year of electricity. Retrofitting 1% of useable roadways (about 10% of total California roads) could service about 70,000 homes during peak traffic hours and about 500 GWh/year of peak load reduction and demand response.

Environmental Benefits: The project will generate electricity through the piezoelectric effect from overpassing vehicles on the road and will displace 3.65 kg/year of CO2. By retrofitting 1% of useable roadways, the environmental benefits will be significant, reducing about 210 kilotons of CO2 emissions and displacing 250 million gallons of fresh water from cooling gas power plants every year.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$234,596

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$582,507

Match Partner and Funding Split:

Pyro-E, LLC: $100,007 (9.1 %)

Match Funding:

$100,007

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team completed basic design for the vibrational energy harvester, with a goal to maximize life under repeated impact and compression cycles from a vehicle. A batch of flexors, for converting vertical compression into horizontal extension, was fabricated and calibrated with force transducers and strain instruments to ensure proper specifications. A uniform subscale piezo-ceramic stack prototype was fabricated and assembled to prevent stress concentrations under buckling loads. Preliminary field testing at subscale was performed to collect data for power and energy. Work has started for permitting with the City of San Jose.

Project Name: EPC-16-053 - Habitat Influences on Desert Tortoise Translocation Success

Recipient/Contractor: Zoological Society of San Diego dba San Diego Zoo Global

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/22/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

With planned expansions in the California deserts, renewable energy projects potentially represent another risk factor for the threatened Mojave Desert tortoise. Head-start methods have been identified as a potential recovery tool and mitigation action for the desert tortoise, but current methods that rely on more than 4 years in captivity are expensive and therefore may be impractical.

Project Description:

The project team is determining if habitat characteristics of the release sites can improve survival rates of smaller juveniles to the point that they are equivalent to the rates of the animals that were released only after reaching the desired size target. Careful measurement of resources that may help tortoises avoid predation or meet nutritional requirements will allow investigators to differentiate excellent habitat from merely adequate habitat. They are also studying the effects of outdoor rearing on juvenile desert tortoise behavior and health, and size-age relationships to survival in the wild upon their release. The project will generate quantitative scientific information about the most cost-effective husbandry and release methods during and following a head-start program for this threatened species.

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

This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on Mojave Desert tortoises. This will be achieved by evaluating the relative effectiveness of head-start and release methods in an experimental framework. Improvements to the effectiveness of habitat management to encourage natural recruitment of juveniles will also be tested experimentally where possible.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

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

Lower Costs: This project is expected to lower costs by making head-start mitigation more cost-effective, reducing obstacles to future renewable energy deployment. It is important to determine the best practice methods for head-starting juvenile tortoises, including reducing time spent in captivity and increasing survival in the wild after release. This will minimize mitigation costs and maximize the contributions of these actions to desert tortoise recovery.

Environmental Benefits: New scientific knowledge on minimum size required at release will guide release site selection and management in the future, while improving survivorship, resource needs, and translocation practices. A better understanding of the habitat features that allow tortoises to thrive can also be applied to guidance for wildlife agencies about which land parcels to protect and set more meaningful restoration targets. Implementation of more effective mitigation practices may increase the probability of de-listing the desert tortoise from the endangered species list in the future. Lessons from the 2018 nest failure will provide important guidance for future mitigation efforts.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$32,237

EPIC Funds Encumbered:

$499,605

EPIC Funds Spent:

$302,441

Match Partner and Funding Split:

Zoological Society of San Diego dba San Diego Zoo Global: $390,528 (43.9 %)

Match Funding:

$390,528

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

14 out of 14 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project completed hatching of the first cohort of 63 hatchling tortoises at Edwards Air Force Base (EAFB). This number should be sufficient for the 18-month old group to be released in 2020. Unfortunately, there was complete nest failure at the Cadiz site. With the advice and consent of the Technical Advisory Committee, researchers developed a plan to overcome this setback by attempting to collect a larger number of eggs in 2019 so that half could be reared indoors to reach the size the 18-month cohort would have achieved. However, they were unable to collect a sufficient number of eggs. Investigating the cause of the nest failure should lead to improved guidance for head-starting. Analysis will still allow evaluation of release habitat, but age/size class comparisons will only be available for EAFB tortoises. The team is collaborating with a complementary project (EPC-16-038).

Project Name: EPC-16-054 - Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/30/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.

Issue:

The CPUC defines electric vehicles as a distributed energy resource along with distributed renewable generation resources, energy efficiency, energy storage, and demand response technologies. There is an issue with integrating and synchronizing vehicle-to-grid (V2G) with the utility, independent system operator, and local distributed energy resource management systems to optimize customer mobility needs and grid energy efficiency. The CPUC's California Storage Mandate requires investor-owned utilities to procure and operationalize 1.3 gigawatts of storage with a provision that V2G technologies are viable for meeting the mandate requirements.

Project Description:

This project develops a "3-in-1" smart inverter, charging station, and building management system. The project focuses on defining and developing control algorithms to implement vehicle-to-grid (V2G) and vehicle-to-building (V2B) with minimal impact to the plug-in electric vehicle (PEV) battery life. This project develops and demonstrates the Smart Power Integrated Node (SPIN) device -- an off-vehicle V2G power conversion and control device that can be applied to residential and small commercial applications. The system integrates a bidirectional direct-current (DC) PEV charger, photovoltaic inverter, and stationary storage battery, with an integrated local energy and power management system for power and energy management, grid communications, and ancillary services.

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

This project will determine the strategies and methodologies for V2G to become a value-added distributed energy resource (DER) asset to reduce ratepayer peak demand and defer grid upgrade costs. Results will inform investor-owned utilities on how V2G and V2B can be a viable resource to meet the Assembly Bill 2514 Storage Mandate and the CAISO energy storage and distributed energy resource initiative. The project will enable validation and valuation of the most effective use cases and intelligently aggregate distributed energy resources to enable and accelerate V2G and V2B charging and discharging strategy adoption to alleviate constrained distribution system nodes.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007

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

Lower Costs: The project will mitigate distribution system stress and maintenance costs through a microgrid and zero net energy operational modes utilizing V2G integrated building DER management and control. The increased integration of renewable energy with V2G-enabled PEVs can provide a value of over $350 million per year in added capacity and reduced grid congestion.

Greater Reliability: The technologies developed under this project can provide ancillary services by combining V2G enabled vehicles' charge and discharge profiles that are locally and distribution system constrained to alleviate localized hotspots. The V2G services will smooth the grid load profile by charging batteries during renewable over-generation and discharging back to the grid during peak load periods, providing approximately 2,000 MW of capacity to the grid.

Environmental Benefits: The V2G-capable PEVs can enable higher penetration of distributed PV by mitigating renewable energy over-generation.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$523,706

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$1,286,987

Match Partner and Funding Split:

Flex Power Control, Inc.: $760,000 (19.8 %)

Electric Power Research Institute, Inc.: $1,220,140 (31.8 %)

Oak Ridge National Laboratory: $250,000 (6.5 %)

National Renewable Energy Laboratory (NREL): $110,861 (2.8 %)

Match Funding:

$2,341,001

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

IEEE 2030.5 Software - A platform independent software implementation of IEEE2030.5, that provides all of the functions required to implement a Server, Client and Gateway. This implementation may be ported to both embedded, SBC or a Cloud processor. An extensive set of API's allow the development of powerful applications.

Update:

The project team has developed and documented the control algorithms to aggregate and balance the vehicle charging, building loads, energy storage, and renewable energy generation. The team has also conducted integration and testing of the SPIN functionalities. Further refinement of the SPIN master communication controller and EVSE communication module is near completion.

Project Name: EPC-16-055 - Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers

Recipient/Contractor: Zeco Systems dba Greenlots

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/30/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.

Issue:

With new PEVs having larger batteries and faster charging capability, direct current (DC) fast chargers for intra- and intercity quick charging needs have risen in demand. DC fast charging is expensive to operate due to high demand charges, and can stress distribution circuits. There is currently no way to manage these demand charges or create any potential new revenue streams to the operator by providing additional services to the grid. Unmanaged DC fast charging can cause the demand load and grid congestion to grow as more DC fast chargers are installed.

Project Description:

The project enables day-ahead and real-time pricing for DC fast charging by developing an integrated hardware and software platform to reduce demand charges from DC fast charging and address intermittency and renewable energy over-generation issues. The site controller and network-based platform advances smart and efficient charging by managing four multi-port fast charging stations to minimize grid impact and lower the cost of operating fast chargers, evaluates the suitability of DC fast charging to participate in demand response programs, and develops and evaluates advanced technologies to efficiently integrate second-life PEV batteries for demand management with DC fast charging. By addressing intermittency and renewable energy over-generation issues, the project will reduce grid impact and increase renewable penetration in the grid by aggregating four DC fast charging stations with stationary battery storage from second-life PEV batteries.

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

This project is advancing the aggregation of DC fast chargers to optimize vehicle charging from either the grid or the stationary battery storage based on the day-ahead and real-time pricing data from the electric utility to reduce grid congestion and mitigate renewable energy over-generation. This optimization will lower the cost of EV charging,

directly translating into cheaper PEV charging for the ratepayers and increase PEV penetration.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007

Applicable Metrics: CPUC Metrics- 1e, 1h, 2a, 4a

Lower Costs: Integrated DC fast charging management with second-life PEV batteries offers lowered operating costs, and can increase operating revenues by more than $4,000 per year for each DC fast charger.

Greater Reliability: Intelligent software control will enable the availability of flexible capacity to the grid, which will allow additional renewable integration and reduced stress on grid during peak hours with demand response capacity.

Environmental Benefits: Using second-life lithium batteries removed from PEVs as energy storage provides another marketable use for these batteries and an alternative to disposal or the more expensive option of recycling.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$826,250

EPIC Funds Spent:

$498,963

Match Partner and Funding Split:

Zeco Systems dba Greenlots: $302,008 (26.8 %)

Match Funding:

$302,008

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

- The patent covers a case when a charge station does not have a direct connection to the network. The patent also includes the concept of queuing, with messaging to drivers to increase utilization of charging stations.
- The patent application is for methods to calculate the likelihood of a demand response event or change in real time price based on measurements from a distributed network of sensors.

Update:

The project team has completed development, testing, and integration of the demand response functionality into Greenlot's SKY (cloud) platform. Greenlots has completed building the base platform and algorithms to support the hardware integration. Smart charging algorithm performance testing and optimization on multiple level 2 PEV chargers in the lab has been completed. Greenlots is preparing their demonstration site for EVSE and battery storage, which will be commissioned by the end of 2019. Field testing and data collection will begin immediately after the site is commissioned.

Project Name: EPC-16-056 - Performance Evolution, Specification and Verification of Building Control Sequences

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/10/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

HVAC building designers lack control strategy tools to compare energy opportunities to reduce energy. In most cases, commercial buildings fail to perform up to their technical design and equipment specifications. The current process of designing, implementing, and commissioning building automation systems is suboptimal. This results in control systems that are expensive and often do not deliver the necessary energy efficiency or comfort level. Annually, more than one quad/year is wasted from common deficiencies in building control design and operation.

Project Description:

The DOE co-funded agreement develops software tools that can be integrated with OpenStudio, which is an open-source software that supports large-scale analysis, including design optimization, model input calibration, building stock analysis, and analysis to develop typical savings values. The project goal is to develop an integrated set of software tools to enable design engineers to use energy-efficient ASHRAE-developed software for commercial buildings. The project is expected to reduce the time to specify, implement and verify the proper operation of building control sequences. The design tool could enable more efficient building operations and reduce operating costs.

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

This federal cost share grant with the US Department of Energy, will develop open source tools to enable verification of building control strategies and will integrate building controls, lighting and HVAC with the smart grid to provide fast and slow demand response. The breakthrough will be that designers can use pre-tested ASHRAE building control sequences or custom sequences, adapt and optimize, and test their impact on energy, peak power reduction, indoor air quality and thermal and visual comfort. The control sequences can be exported to the control vendor to obtain cost estimates and can be used by commissioning agents to verify that the original design intent is realized. This will enable accountability for controls performance between design and operation and is expected to have broad adoption and impact.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: Use of the tools could reduce energy use in commercial buildings and equipment maintenance costs. The tool can enable improved design and implementation of building controls that minimize costs associated with design, construction, operation and maintenance. If this technology was widely adopted for 50% of the existing medium and large commercial buildings, it could achiev a 12 percent reduction in energy, with a potential cost savings as high as and ~0.05 quads/yr in California, saving IOU ratepayers ~$0.3B/yr.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$473,633

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$910,349

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy : $2,750,000

Kilowatt Engineering, Inc. dba kW Engineering, Inc: $20,000

Stanford University: $75,000

Integral Group, Inc.: $75,000

Controlco: $75,000

CBRE: $70,000

Leveraged Funds:

$3,065,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

43 bidders

Rank of Selected Applicant/ Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team reviewed the control sequences for primary systems based on a new version of ASHRAE released in July, 2019. Due to the complexity of the task due to these updates, there were delays. The team expects to finalize the first version of testing by the next quarter. The modeling for the case study remains on hold until the testing is completed because these sequences are required for the case study. A quarterly project review meeting was held with DOE and CEC in January 2020. The project achievements to date have been positively received by ASHRAE and others in the industry. The team has documented the potential to reduce heating, ventilation, and air-conditioning system energy use by 30% through the use of advanced controls for secondary systems. Next, the team will complete the modeling case studies for the primary HVAC system.

Project Name: EPC-16-057 - Development of Smart Charging Infrastructure Planning Tool (SCRIPT)

Recipient/Contractor: Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/30/2017 to 7/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.

Issue:

Plug-In Electric Vehicle (PEV) growth has the potential of adding stress to the grid. There are also tradeoffs between maximizing the use of PEV charging infrastructure and building more infrastructure to facilitate flexibility and market growth. A congested charging station has limited flexibility for demand management through smart charging, while a more expansve charging infrastructure network allows PEVs to stay plugged in longer than the minimum charging time without affecting other drivers' travel plans and providing additional flexibility for smart charging.

Project Description:

This project is developing the Smart Charging Infrastructure Planning Tool (SCRIPT) that will produce spatial-temporal forecasts of electric vehicle (EV) charging demand and flexibility. The SCRIPT tool is being tested to determine daily predictive smart charging strategies that will anticipate future travel needs of drivers and grid conditions. SLAC is studying the role of different charging infrastructure investment strategies in the effectiveness of EV smart charging techniques to accommodate state level renewable penetration goals in California. SLAC is testing the tool using real-time charging data to determine the maximum amount of solar generation that can be absorbed by the vehicles through smart charging. SLAC is also studying the tradeoffs between investing in new charging infrastructure compared to better management of existing infrastructure via smart charging.

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

There are significant benefits from workplace smart charging that may be shared with the vehicle owners. By exercising the flexibility of the vehicle charging in the workplace, commercial customers can save from energy and demand charge costs. Smart charging can decrease energy charges by up to 1.5% of the overall utility bill, and decrease demand charges by up to 24.7%. Further benefits can be achieved from adding PV as a distributed energy resource at a site, but even without that addition there are significant

benefits to both the EV owner and workplace where the EV is being charged. The project team is conducting a cost-benefit analysis that will inform the final report.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007

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

Lower Costs: The predictive smart charging system allows PEV owners to charge during the periods of the day when energy is the cheapest. SCRIPT also allows for intelligent management of the existing charging and grid infrastructure, which reduces maintenance costs and future equipment costs.

Greater Reliability: SCRIPT's predictive smart charging algorithms will allow PEVs to intelligently charge during periods of renewable energy overgeneration, which reduces the amount of energy flowing back into the distribution grid.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$328,945

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$1,391,076

Match Partner and Funding Split:

ChargePoint, Inc.: $32,808 (2.1 %)

UC Santa Barbara: $61,345 (3.8 %)

Match Funding:

$94,193

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The Smart Charging Infrastructure Planning Tool (SCRIPT) continues to be developed. The preprocessing and data upload has been completed, and the next key tasks will focus on completing the user interface for SCRIPT. The remainder of the project term will complete development of the SCIPT tool and support iterations based on Technical Advisory Committee feedback. SLAC will continue with analysis and improvements and finalize implementation of the cost-benefit analysis in the tool.

Project Name: EPC-16-058 - Advanced Transit Bus VGI Project

Recipient/Contractor: Prospect Silicon Valley

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/15/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.

Issue:

California has established ambitious goals for zero emissions vehicles (ZEV), including the California Air Resources Board's proposed initiative for 100% transit conversion to ZEVs by 2040. Currently, electric buses (e-bus) are significantly more expensive than conventional buses and are complex and costly to integrate into current transit agency bus operations (e.g., integrating into existing routes because of charging needs). However, there is the potential to get more value out of the e-buses to support state renewable goals and grid reliability.

Project Description:

This project addresses critical real-world needs to commercialize and scale electric transit fleets with robust grid-serving energy services. Leveraging Santa Clara Valley Transit Authority's (VTA) plan to purchase up to 35 all-electric buses to electrify its 500-bus fleet, the project team will demonstrate strategies to improve the business case of e-buses, including reducing cost via advanced management, establishing revenue generation opportunities, addressing commercial fleet management needs, and ensuring benefits reach all communities by delivering e-bus transit to underserved communities.

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

The project will make the following advances by: 1) translating automotive VGI advancements to a commercial e-bus fleet, including retail and wholesale energy services; 2) delivering advanced optimization of battery life and cyber security; 3) integrating energy services and management with leading commercial fleet management tools; and 4) integrating key Energy Commission funded VGI platforms and providing a roadmap for statewide deployment.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007

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

Lower Costs: The project will lower costs for transit agencies including a projected $220K per year in reduced demand charges and energy services revenues from this pilot. The project will also result in reduced grid costs by providing significant grid services at lower cost than dedicated assets purchased for such services.

Environmental Benefits: Accounting for California electric carbon intensity, this project will reduce 4,000 metric tons of CO2 (MMtCO2) per year representing a 78% reduction from the current buses. A statewide conversion would reduce 2.4 MMtCO2 per year - 1.5% of current statewide transportation carbon emissions.

Public Health: Conversion to e-buses significantly reduces criteria pollutant emissions, particularly NOx, CO, VOCs and particulate matter, especially important for underserved communities. For the pilot, assuming replacement of typical diesel buses, annual reductions of up to 255,000g CO, 21,000g hydrocarbons, 3,200g NOx and 170g PM could be achieved. VTA serves an estimated 500,000 residents in underserved communities.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$412,909

EPIC Funds Encumbered:

$1,899,199

EPIC Funds Spent:

$951,651

Match Partner and Funding Split:

Santa Clara Valley Transit Authority: $1,005,018 (34.3 %)

Proterra Inc.: $30,000 (1.0 %)

Match Funding:

$1,035,018

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-058 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team was focused on developing the Energy Management Platform (EMP), which serves the smart charging needs of the electric bus fleet and will be used to determine best practices for wide scale adoption. The development of the EMP was a coordinated effort amongst many subcontractors. Communication systems were implemented at VTA facilities as well as on the electric buses to develop seamless communications between the electric buses and the EMP at VTA. Bus state-of-charge range, efficiency, odometer readings, and MAC ID settings between the actual busses and the EMP were successfully tested for full integration at VTA.

Project Name: EPC-16-059 - Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Service and Renewable Power Penetration

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 10/11/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S9: Advance Electric Vehicle Infrastructure to Provide Electricity System Benefits.

Issue:

Plug-in electric vehicles (PEVs) can provide energy storage needed to support renewable power generation through vehicle-to-grid (V2G) and vehicle-to-building (V2B) services. However, the risk of accelerated battery degradation is commonly cited as a concern inhibiting the implementation of V2G and V2B technology. Additionally, second-life battery applications can provide value after a battery pack has exhausted its useful life in a vehicle. Real-world demonstrations are needed to complement existing battery degradation models, projections, and recyclability economic models to promote second-life battery future use in V2G and V2B applications.

Project Description:

This project demonstrates an automated control system for a fleet of PEVs and repurposed second-life batteries that reduces the overall cost of ownership by maximizing battery lifetime, shifting load to minimize electricity and demand charges, and providing V2G and V2B services, including those supporting the use of onsite solar generation. The demonstration adds a stationary second-life battery installation to the existing PEV fleet site at the Los Angeles Air Force Base.

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

This project is developing and implementing an optimization and control algorithm for a fleet of PEVs and stationary battery packs that includes impacts on battery health expressed as an economic cost, using models and parameters derived from actual battery measurements. These activities will help demonstrate PEV ownership lifecycle cost reductions and will advance scientific knowledge of the impacts of V2G and V2B services on mobile and second-life PEV batteries.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Energy storage: R.15-03-011 (closed)

Applicable Metrics: CPUC Metrics- 1h, 3f, 4b

Lower Costs: The project reduces the lifecycle cost of PEV ownership for fleets by increasing the useful capacity and lifetime of PEV batteries, including accounting for recycling costs and waste generation from manufacturing new batteries. Utility costs can also be lowered through load shifting and demand management. For 10% of commercial and government fleet vehicles in California converting to PEV and the corresponding number of second-life batteries that could be installed at fleet sites, the per battery (both PEV batteries and second-life batteries) savings from peak demand shifting is estimated to be about $400 per year, or $62M per year in aggregate.

Environmental Benefits: PEV batteries removed from transportation service but retained as storage assets at their primary location will result in significant increases in useful service life before recycling. Furthermore, a CEC report forecasting the potential impacts of second-life batteries predicted that 15% of the expected annual reduction in greenhouse gases could be achieved using second-life batteries for peak shifting.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$407,071

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$981,533

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team upgraded the existing 13 Princeton Power Systems (PPS) charging stations with new computers and the latest software at the time to provide V2B capabilities. In April 2019, four out of the 12 Nissan EVs have been upgraded with new battery packs. However, the project team confronted multiple challenges, including communications issues between PPS charging stations and the EVs and the bankruptcy of PPS. These issues have delayed the second-life battery phase of the project.

Project Name: EPC-16-061 - Intelligent Electric Vehicle Integration (INVENT)

Recipient/Contractor: Nuvve Corporation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/3/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.

Issue:

As the Plug-in Electric Vehicle (PEV) population grows in California, the demand for electricity as a transportation fuel may lead to congestion and overloading on the transmission and distribution grid. Simultaneously, increasing the introduction of renewable energy sources requires adoption of more closely coordinated grid capabilities to effectively regulate grid voltage and frequency on a real-time basis and address morning and afternoon ramping.

Project Description:

This project is deploying vehicle-grid integration (VGI) technology with unidirectional and bidirectional power flow capabilities using light fleet and consumer vehicles. These vehicles will provide local grid support by controlling the charge rate based on locally available energy and power capacity, controlling the voltage, and providing grid-wide support by participating in frequency regulation or adjusting the reactive power. The mix of services provided will be optimized within a campus laboratory setting with the goal of expanding this technology into a real-world setting.

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

This project is developing an advanced VGI technology to optimize the blend of unidirectional charging, bidirectional operation, and vehicle-to-building functions, for different real-world grid applications such as frequency regulation, power quality, voltage control, and grid support. The project will show the value of EVs as distributed energy resources, with the ability to defer or eliminate the need for grid upgrades, and enable greater renewable energy penetrations.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1h, 3f, 4b

Lower Costs: The combination of load adjustment and energy storage is the most cost-effective way to integrate PEV and renewable energy sources at the same time. By sharing the battery in a PEV when the PEV is not used (parked and connected) the grid will have access to a low cost distributed storage resource, which in turn will make it possible to introduce more non-dispatchable renewable energy such as solar or wind.

Greater Reliability: Since the batteries in the EVs function as distributed storage resources, they can improve grid reliability by stabilizing the grid-wide frequency as well as mitigating local grid overload in transformers or feeders.

Environmental Benefits: Helping to make EVs more affordable by identifying revenue creating strategies will increase the penetration of EVs. This will help to lower local pollution by reducing fossil fuel consumption within local transportation, especially in large cities.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$212,026

EPIC Funds Encumbered:

$4,200,000

EPIC Funds Spent:

$1,709,724

Match Partner and Funding Split:

The Regents of the University of California, San Diego: $335,604 (4.2 %)

Strategen: $13,100 (0.2 %)

FleetCarma: $13,892 (0.2 %)

Nuvve Corporation: $3,335,148 (42.2 %)

Match Funding:

$3,697,744

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

29 out of 31 bidders

Rank of Selected Applicant/ Bidder:

Group 4: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The owner of the Patent is the University of Delaware with patent number 9,043,048, and the length of the patent is from Sep. 21 2010 through May 26, 2015.

Update:

In 2019, Nuvve successfully demonstrated and operated nine uni-directional and nine bi-directional charging stations on the UCSD campus. These charging stations have demonstrated frequency regulation, demand response, and demand charge management as part of Nuvve's use cases. Also, Nuvve has shown the implementation of uni-directional demand charge management at one of the UCSD parking garages resulting in potential savings to the building in its monthly electric bill. Furthermore, Nuvve announced the participation of Honda Motors of North America in the INVENT project as a project partner by providing three retrofitted, bi-directional Honda Accord PHEVs. These vehicles will participate as part of Nuvve's INVENT project by expanding the existing fleet of bi-directional EVs to demonstrate the use cases mentioned above with a diverse pool of vehicles.

Project Name: EPC-16-062 - Advancing Demand Response in the Water Sector

Recipient/Contractor: Regents of the University of California, Davis

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/5/2017 to 3/30/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Water utilities are high electricity users responsible for about 10% of the state's electricity demand, but lack the ability to easily participate in demand response events or shift loads to reduce their energy costs. A water utility's energy uses are complex and their understanding of effective ways to meet inflexible demand needs and also electric load management for demand response is lacking. Finding feasible, energy cost saving solutions requires assessment of the conditions at the plant, the system configuration, and assessing real time water and energy data.

Project Description:

This project is developing a demand management system to optimize energy use and operations using the Moulton Niguel Water District as a pilot site. By better optimizing its system, the water utility will be able to reduce its energy bill by participating in demand response and load shifting incentive programs. The project will optimize load for the potable and recycled water systems at Moulton Niguel while developing a software platform and management system that can be easily adopted by other water districts and utilities.

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

The demand management system uses real-time energy analytics to: (1) reduce and/or shift peak energy loads, (2) account for different energy tariff structures, and (3) balance the grid's intermittent renewable load generation. This demand management tool enables water utility participation in demand response and load shifting utility programs. Along with marketing and communicating the technology, the tool will inform other water utilities, and could result in increased use and acceptance. Given the impact of energy consumption by the water industry in California responsible for 10% of the state's electricity demand, widespread use of the proposed methodology could help achieve energy demand reduction needed to support the state's energy goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Water-Energy Nexus: R.13-12-011 (closed)

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

Lower Costs: This project could lower costs for the water utility through participation in energy utility demand response programs. It could also result in a reduction in system costs through avoided demand charges and reduced constraints on the electric grid during congested periods. Moulton Niguel is expected to reduce peak demand by 25% using the technology solution.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$282,171

EPIC Funds Encumbered:

$2,984,983

EPIC Funds Spent:

$95,959

Match Partner and Funding Split:

Moulton Niguel Water District: $90,865 (2.9 %)

Helio Energy Solutions: $14,900 (0.5 %)

Match Funding:

$105,765

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 2: 6 out of 7 bidders

Rank of Selected Applicant / Bidder:

Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The intellectual property contains patent and trade secret to "PredictEnergy" software owned by Helio Energy Solutions. The proprietary technology will be used to develop the products in multiple tasks in this agreement.

Update:

The team has developed an energy grid model and continued to add features to the demand management system (DMS). The team continued to refine data and inputs to the energy demand management system software, including gathering tariff and grid operation characteristics information from the utilities and the California Independent System Operator. The research team has been adding features to the demand management system to optimize energy demands of water systems. A working prototype of the DMS has been developed and is currently being tested at the water utility for final refinements before a full-scale demonstration.

Project Name: EPC-16-063 - Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning

Recipient/Contractor: University of California, San Diego

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/30/2017 to 8/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

There are two basic ways to produce climate scenarios for California. One of them involves the use of dynamic regional climate models. These "weather forecast models" are very expensive to run. The second option is to use statistical methods that use historical relationships with outputs from global climate models to create high resolution climate scenarios for California. This approach is far less expensive than running an entire weather forecast model but it is unclear if the historical statistical relationships will be valid under future conditions. The researchers will develop and test a hybrid downscaling technique that will merge the benefits of statistical and dynamic models.

Project Description:

This project develops new and better ways of merging two modeling approaches, using both weather forecast models (more generally called dynamical models) and inferences from past history (statistical models). The combined method is called a hybrid dynamical-statistical approach for inferring fine-resolution climate information from the coarse-resolution global climate models. Ideally, the hybrid approach will be able to capture many of the physical processes simulated by the costly weather forecast models, but with the reduced expense of statistical models. The hybrid approach will be applied to three key areas of California's climate that have important implications for the state's ratepayers: wind, clouds, and hydrology.

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

The project will include an extensive quantification (model validation) effort, which will be based on data from observed meteorological stations, satellite records of cloudiness compiled by project members, and USGS stream-flow and groundwater observations (for the hydrologic modeling). The method under development could be used for the California's Fifth Climate Change Assessment and future energy planning.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 5c

Lower Costs: Knowing how the climate is likely to change provides a sound scientific basis for minimizing economic impacts on the electricity system. For example, better projections of wind fields at heights of interest to wind generation and at appropriate time scales (i.e., sub-daily) will help guide long-term planning for wind generation. Improved, cost-effective planning for integration of renewables to meet California's Renewables Portfolio Standard potentially has significant benefits for California ratepayers.

Greater Reliability: This research will develop a method to produce high-resolution projections of climate parameters that are of great importance for managing the electricity system, in particular for managing peak demand and for shifting to a grid that is dominated by low-carbon, intermittent resources. For example, improved understanding of how low-lying coastal cloud cover is projected to evolve can improve planning for peak demand. Similarly, improved understanding of the availability of intermittent renewable generation fosters better management. This potentially has significant benefits in the form of increased reliability for California ratepayers.

Increase Safety: This research supports predictive modeling, providing information on how the climate is likely to change, which can be used to limit impacts to residents, infrastructure, and the economy. This has significant potential benefits for California ratepayers.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$192,928

EPIC Funds Encumbered:

$1,399,888

EPIC Funds Spent:

$300,471

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

14 out of 14 bidders

Rank of Selected Applicant/ Bidder:

Group 6: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team is running dynamic regional climate models and exploring the use of statistical models for hourly simulations. In the past, climate scenarios for California only included projections with daily resolution. The Energy Commission's Energy Forecast Office is moving towards hourly forecasts. The research team has made significant progress on key areas, including development of a training dataset for wind speed and direction at hub height as well as daily precipitation, and some preliminary results will be available early in 2020.

Project Name: EPC-16-064 - Investigating Avian Attraction to Solar Energy Facilities Through a Lake Effect

Recipient/Contractor: US Geological Survey

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 3/11/2018 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

PV utility-scale solar facilities in California (and elsewhere) are sources of bird mortality. Currently, it is unknown what behavioral processes and mechanisms lead to bird mortality observed at solar facilities. The leading hypothesis suggests that large fields of photovoltaic panels reflect light in a manner similar to large bodies of water. Moreover, the presence of these water-like surfaces in arid landscapes may add to their attractiveness to passing birds. Left unaddressed, this problem will lead to increased costs to ratepayers as solar energy projects face greater environmental permitting and mitigation challenges associated with developing and operating these facilities.

Project Description:

Researchers are exploring the behavior of attraction by birds to solar facilities, particularly in relation to the "lake effect" hypothesis. Specifically, they are studying 1) the ability of birds to detect potentially attractive visual cues associated with solar facilities (e.g., polarized light, irradiance); 2) the corresponding change in flight behavior characteristic of movement toward solar facilities; and 3) the mortality and natural history of birds that actually occupy solar facilities. First, the recipient is examining the sensory basis of attraction through field and lab experiments. Second, radar and thermal imaging are used to measure the degree to which birds alter their flight paths to settle at solar facilities. Data on behavior and mortality from multiple solar facilities are gathered to inform a statistical model to determine what characteristics of solar facilities and species' natural history together explain variations in mortality exhibited across sites.

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

This project is the first systematic study to determine whether birds are attracted to solar energy facilities and if so, to develop an understanding of the sensory basis and proximal response of birds to solar facilities in relation to the "lake effect" attraction phenomenon. Following from that new understanding, the project will identify potentially viable

methods for deterring birds from approaching solar facilities and informing future siting decisions in ways that reduce the likelihood of birds encountering solar facilities.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 4f, 4g

Lower Costs: This project will lower costs by streamlining the permitting process of renewable energy projects in California. Renewable energy projects are often delayed because information on the impacts on wildlife required by state and federal law is insufficient or unavailable. Better information on the effects of these projects will reduce permitting delays. The findings of the research may also help to focus pre-construction surveying and post-construction monitoring and mitigation actions to the species at greatest risk from this form of attraction, which would also reduce the soft costs of deployment of solar energy technologies.

Environmental Benefits: By combining mortality and natural history data with new data gathered during the project, solar energy companies, state and federal agencies, and the public will have access to the best information for risk assessment and future siting decisions. The eventual adoption of such techniques reduces the likelihood that solar facilities impact species of concern, particularly state and federal threatened and endangered species. Suggestions for deterrent and mitigation strategies may lead to the application of technologies that reduce bird mortality.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$200,240

EPIC Funds Encumbered:

$499,785

EPIC Funds Spent:

$252,200

Match Partner and Funding Split:

United States Geological Survey: $348,152 (28.1 %)

Bard College: $75,390 (6.1 %)

Humboldt State University Sponsored Programs Foundation: $12,244 (1.0 %)

8minuteenergy Renewables, LLC: $50,000 (4.0 %)

First Solar: $50,000 (4.0 %)

NextEra Energy: $50,000 (4.0 %)

NRG Energy, Inc.: $50,000 (4.0 %)

Recurrent Energy: $100,000 (8.1 %)

Western EcoSystems Technology, Inc.: $4,465 (0.4 %)

Match Funding:

$740,251

Leverage Contributors:

United States Geological Survey: $22,000

Undisclosed Source: $28,000

Leveraged Funds:

$50,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

14 out of 14 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The first and second field seasons of data collection were successfully completed for both radars at the Desert Sunlight Solar Facility, as well as a bird carcass search and bird use surveys at several additional solar photovoltaic facilities across southern and central California. These data are in the process of being analyzed. The experimental tasks to study bird attraction to polarized surfaces are underway.

Project Name: EPC-16-065 - California E-Bus to Grid Integration Project

Recipient/Contractor: Zero Net Energy (ZNE) Alliance, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/30/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.

Issue:

On-road diesel emissions are a key factor in lung disease and the state's asthma epidemic. Electrification of transit represents a tremendous opportunity to achieve cornerstone climate goals such as Assembly Bill (AB) 32, State Bill (SB) 350, and Executive Orders B-30-15 and B-16-2012. Cost and reliability are the largest barriers to scaled adoption of electric buses (E-bus). For transit fleets there is the added challenge of integrating E-buses into their bus schedules and ensuring that drivers are properly trained on how to operate them.

Project Description:

This project focuses on improving the economics of incorporating e-buses in a transit agency fleet. The project team is working with the Antelope Valley Transit Authority (AVTA) to evaluate multiple scenarios, including smart charging, improving vehicular energy efficiency through best driving practices, and using the vehicle batteries for grid services when the E-buses are not being used for their routes. More effective smart charging reduces the frequency and duration of in-route charging, and the fuel economy improvements that come from smart driving result in operational cost savings. By reducing the likelihood that several/all E-buses will be charging at once, the smart charging platform will achieve greater flexibility to mitigate demand charges and provide grid services.

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

E-Buses have the technical and economic potential to rapidly displace diesel and CNG transit buses given current replacement cycles. Buses are being deployed with onboard telematics to understand the vehicle's operating health and parameters, and high-power wireless inductive charging is now a viable solution for in-route charging. Together, these technologies help overcome range limitations and uncertainty. However, while these technologies alone provide great value and overcome key adoption barriers, integrating them with analytics and distributed energy resource (DER) management platforms will unlock even greater value.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

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

Lower Costs: This project evaluates the lifecycle costs of EV buses through smart charging operation which will smooth the demand spike during nighttime depot charging and demonstrate how to minimize demand charges during the day when buses need to be using high-powered chargers. By using suitable strategies, it is expected that EV buses will be shown to be more cost competitive with diesel buses.

Greater Reliability: Development of smart charging will provide fleet operators and grid service providers with greater reliability and control as the grid adapts to an increasing penetration of intermittent renewable energy sources, excess generation, and diverse portfolios of DERs.

Public Health: The electrification of transit fleets would have enormous impacts on public health, as diesel use is one of the biggest sources of particulate matter and causes of childhood asthma. Additionally, the project will pave the way for greater transit vehicle electrification, which could ultimately save ~1.7 MMTCO2e per year in the State of California alone.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$792,573

EPIC Funds Encumbered:

$3,327,953

EPIC Funds Spent:

$1,849,760

Match Partner and Funding Split:

Antelope Valley Transit Authority: $3,729,000 (52.8 %)

Match Funding:

$3,729,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

29 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team has installed six wireless opportunity chargers on two different bus routes. These chargers are used to increase the maximum range of the E-Buses. The team has developed an E-Fleet Energy Model that accounts for the effects of weather, geography, drivers' skill and other factors on the kWh/mi. efficiency of the E-Buses. Fleet operators are seeing the benefits of driver training in reducing the fleet's overall energy usage. The team has also achieved peak load shaving through scheduled charging and it has studied the potential benefits of VGI-related grid services on a transit fleet scale. An E-Bus Deployment Guide has been prepared for fleet operators throughout the state.

Project Name: EPC-16-067 - Robust Super Insulation at a Competitive Price

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/14/2017 to 12/2/2020

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Currently, conventional building insulation is economical but has low R-values. There are emerging technologies with high R-values but are expensive. There is a need to develop a robust insulation with a high R-value to significantly reduce cooling and heating loads that can be sold at a competitive price.

Project Description:

Heating and cooling represents the greatest energy consumption in buildings. This project is developing thermal building insulation material with high R-value at a cost commensurate with conventional insulation materials. The product is expected to provide a significant increase in energy savings for existing buildings.

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

Currently, there is no thermal building insulation material that can cost-effectively be assembled with high R-values. This Department of Energy cost share agreement is developing a manufacturing process to achieve a high R-value and decrease the installed thickness of the insulation, at a competitive price. This will make retrofits easier because much less space will be needed to accommodate existing building wall assemblies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1h

Lower Costs: If successful, the insulation material could achieve 2 to 4 times increase in R-value at a price competitive with current insulation materials. This higher R-value will reduce heating and cooling costs to building owners and tenants.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$42,679

EPIC Funds Encumbered:

$100,000

EPIC Funds Spent:

$100,000

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

U.S. Department of Energy : $1,500,000

Lawrence Berkeley National Laboratory: $100,000

Leveraged Funds:

$1,600,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Technical results will be made public after securing intellectual property, as is customary.

Update:

The DOE funded agreement has concluded and the recipient has submitted a draft final report. The team hopes to apply to DOE for future funding to continue work on thermal conductivity. During the course of this project, the team tried various techniques to improve flexibility without compromising the thermal performance. They tested samples for R values to ensure the insulation material performance would not become less stable over time. The observations show that both rigid and flexible insulation samples showed no degradation in the thermal performance after 6 months. They have achieved an R/inch of 9.02 for the one-inch flexible insulation samples however, one of the main challenges is the scale up to create a larger sample size.

Project Name: EPC-16-068 - Integrated Community-Level Solutions for Resource Management for a Grid and Customer Benefits

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/18/2017 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

California seeks to make energy innovations serve all of society so that everyone can derive the economic and quality of life benefits from a clean energy future. Many technical research gaps need to be addressed to help realize this goal, including the following: (1) assessing new, high-efficiency solar technologies that can address space constraints in commercial and multifamily buildings, (2) testing how integration of solar, energy storage, and connected end-use load control can help manage customer needs with electrical grid benefits and (3) evaluating approaches to enable community solar and storage as a tool to enable grid reliability.

Project Description:

This project demonstrates the feasibility of using an integrated community-scale solar plus storage system, sited at a low income multi-family disadvantaged community in Willowbrook, CA. The technology solution balances a combination of grid-connected distributed energy resources (DERs), including advanced solar PV, energy storage, smart inverter, and load management. The project team is working with Southern California Edison to study the distribution grid impacts that the DERs can mitigate, realizing cost savings and enabling increased PV penetration. It is also investigating innovative business strategies to maximize the value of DERs to both end-users and the utility. Another objective of the project is to demonstrate a cost-effective solution to achieving Zero Net Energy (ZNE) within an affordable housing community to realize California's 2020 goal for new sustainable and scalable ZNE communities.

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

The project includes high efficiency bifacial 355 W solar modules manufactured by Canadian Solar that can substantially assist commercial and multifamily buildings with roof area constraints, as well as the integration of solar and storage with smart inverters that include segmentation of storage for meeting multiple needs. The project also

demonstrates a platform that can manage both loads and storage while integrating DC mini grids to eliminate conversion losses for solar PV.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Self-Generation Incentive Program: R.12-11-005 Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a, 3f, 4a, 4b

Lower Costs: The project will demonstrate energy savings of 231,240 kWh to the grid on an annual basis from the solar generation. With the inclusion of an additional 10% savings through reduction in conversion losses and another 10% through energy efficiency measures, the project will save 289,050 kWh annually. If this project were replicated to cover 15% of California residential energy use (20% of ratepayers are low income, and 75% of low income is multifamily), Californian's total energy bills would be reduced by $185 million per year.

Environmental Benefits: The project shows a potential, if replicated to cover 15% of California residential energy use, for energy use reduction of 1089.4 GWh per year, which translates to statewide CO2 reduction of 397,631 tons per year.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$864,761

EPIC Funds Encumbered:

$2,976,991

EPIC Funds Spent:

$357,203

Match Partner and Funding Split:

OhmConnect, Inc.: $108,000 (2.7 %)

Chai Energy: $25,000 (0.6 %)

Nextek: $10,000 (0.3 %)

Electric Power Research Institute, Inc.: $394,445 (9.9 %)

LINC Housing Corporation: $405,455 (10.2 %)

Gridscape Solutions, Inc.: $60,000 (1.5 %)

Match Funding:

$1,002,900

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

EPRI developed a tool called the "Distribution Resource Integration and Value Estimation" tool or "DRIVE". The tool was developed through funding from EPRI's utility members. The tool is embedded in distribution planning software made commercially available by license. DRIVE is pre-existing IP.

Update:

The project experienced several issues in the execution of the subcontract agreement between EPRI and LINC Housing, and a significant personnel turnover at LINC Housing that impacted the start of the construction. As a direct result, an amendment was executed in September, 2019, for a 9 month no-cost time extension from June 30, 2020, to March 31, 2021. The construction permit was approved by the County of Los Angeles but experienced a delay. The PV modules were delivered on site in September 2019 but were also delayed due to issues in the procurement process from Canadian Solar, because there was a general shortage supply in the market due to trade tariffs. The interconnection plan has been reviewed and approved by SCE. The construction is anticipated to be completed by December 2019 with data gathering to start immediately thereafter.

Project Name: EPC-16-070 - Integrating Front-of-the-Meter Energy Storage with Smart PV Inverters and Solar Forecasting

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/30/2017 to 12/31/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market and Improve Grid Reliability.

Issue:

Although it is recognized that in front-of-the-meter and community-scale storage projects can benefit the grid and may be able to provide higher value to customers, it is not yet clear what those values are, how they can be maximized, or how to minimize the impacts of high penetration of renewables (e.g., in a community).

Project Description:

The purpose of this agreement is to design and install in front-of-meter energy storage with smart PV inverters and solar forecasting. The research will demonstrate a cost-effective and scalable solution that integrates distributed energy resources to address grid needs and identify cost reductions and revenue-generating opportunities for developers and commercial customers.

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

The project will demonstrate an interoperable solution that integrates in front-of-the-meter energy storage with smart PV inverters and satellite-based solar forecasting to address grid limitations. The idea will enable PV as a grid asset through beneficial integration with storage, capacity management, and communications. To accomplish this, advanced modeling techniques will be used, including EPRI's existing tools for hosting capacity calculation and energy storage value simulation. Advancements that will result from this demonstration will enable aggregated DER control and optimization.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) SB 1122 Bioenergy feed-in tariff: R.11-05-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

Applicable Metrics: CPUC Metrics- 1a, 1e, 3a, 4a

Lower Costs: This project will demonstrate the financial opportunities for in front-of-the-meter storage. The demonstration will evaluate revenue streams that can defer the cost of the system and provide additional energy savings in a facility by reducing daily load.

Greater Reliability: The project will provide new data, analysis, and design for cost-effective integration of distributed PV with energy storage. This will improve reliability at two levels: (1) at the distribution system level, by mitigating adverse PV impacts such as voltage violations; and (2) at the bulk level, by leveling out the "duck curve" and limiting dependency on operating reserves.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$644,129

EPIC Funds Encumbered:

$1,832,770

EPIC Funds Spent:

$311,168

Match Partner and Funding Split:

Craig Wooster Engineering: $361,685 (14.9 %)

Electric Power Research Institute, Inc.: $229,753 (9.5 %)

Match Funding:

$591,438

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

31 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 6: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

EPRI is in the process of obtaining the interconnection agreement with PG&E. EPRI updated the system design of the in front-of-the-meter energy storage system and resubmitted the interconnection application to PG&E in August 2019. The initial supplemental interconnection report from PG&E was positive. The team expects an executed interconnection agreement with PG&E by December 2019.

Project Name: EPC-16-073 - Valencia Gardens Energy Storage

Recipient/Contractor: Natural Capitalism Solutions, dba Clean Coalition

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/1/2017 to 3/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market and Improve Grid Reliability.

Issue:

Traditionally, renewable energy located on the distribution grid has been deployed one rooftop at a time, without basing investment decisions on an assessment of a local area's energy system potential as a whole, and without the integration and automation of all the required components that accelerate and scale these deployments. The absence of an integrated distributed energy planning process hinders more widespread use of distributed renewable energy technologies even though these technologies offer opportunities to create a cleaner, more affordable, and stronger electrical system.

Project Description:

The purpose of this project is to utilize energy storage in front of the meter to increase the ability of the distribution grid to support more local solar while improving overall grid operations and economics. This project will provide a replicable model for California by demonstrating multiple uses: interoperability with normal grid operations, including participation in existing wholesale market opportunities, and enhanced interconnection hosting capacity to accommodate far more local solar; and indefinite solar-driven backup power for prioritized loads. Additionally, this project will recommend advancements in policy, interconnection processes, and market mechanisms that maximize and recognize the full value of local energy storage deployments that are interconnected in front of the meter.

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

This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of California's statutory energy goals by utilizing energy storage as a local balancing and optimization solution on a circuit on the distribution grid. The project will demonstrate a combination of advancements and breakthroughs including, but not limited to, an advanced local energy system that utilizes energy storage on a circuit to optimize local circuit balancing, increases PV hosting capacity and provides the California Independent System Operator with ancillary services.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1e, 1h, 4a, 5b

Lower Costs: The project team estimates that this system will result in $240,000 in peak capacity savings and $425,000 in transmission and distribution line loss savings.

Greater Reliability: This project will enable higher penetrations of distributed renewable energy, improve circuit reliability, and optimize local balancing of electricity supply and demand. It will utilize indefinite, renewables-based backup power to critical loads in a disadvantaged community during grid outages to achieve greater community resilience.

Environmental Benefits: By enabling greater local penetration of PV, this project will contribute to a decrease in the reliance on fossil fuels for electricity generation, and thereby reduce greenhouse gas emissions and other hazardous emissions from power plants. The project team estimates that the10 MW of PV in the project area will yield 15,785 MWh of emissions-free generation per year, which is equivalent to offsetting the emissions of 2,052 average homes in PG&E territory.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$251,310

EPIC Funds Encumbered:

$1,994,687

EPIC Funds Spent:

$797,687

Match Partner and Funding Split:

PATHION, INC: $620,470 (23.7 %)

Match Funding:

$620,470

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

31 out of 35 bidders

Rank of Selected Applicant/ Bidder:

Group 6: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the Valencia Gardens project team executed the interconnection agreement with PG&E and has been actively working with PG&E to finalize the construction of the in front of the meter storage system. The project had challenges in scheduling the construction with PG&E, which is essential to complete the installation of the energy storage at the demonstration site. Clean Coalition held working group meetings with PG&E and PATHION to coordinate efforts to expedite the construction and to complete this project successfully. The team is expecting to obtain the permit to operate by Match 15, 2020.

Project Name: EPC-16-077 - Solar+ Storage Integrated Energy Management Demonstration in a Supportive Housing Facility

Recipient/Contractor: The Regents of the University of California, on behalf of the Riverside Campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 1/31/2018 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Battery Energy Storage System (BESS) integrated energy management activities have the risk of potentially increasing peak demand and peak utility loads. Behind-the-meter photovoltaic (PV) generation is also uncontrolled by the utility. Unmanaged energy production and storage creates additional challenges for utility energy management and distribution. Pairing PV and BESS with controls and managed loads has great potential, but community-scale PV and BESS solutions at multi-family residences have struggled to be adopted in California, as there have been limited demonstrations that such systems can provide benefits to the building owner, tenants, and the grid simultaneously.

Project Description:

The project deploys a 100 kW high-performing solar PV system, a 150 kW/150 kWh li-ion battery energy storage system, a smart inverter, and an advanced energy management platform to demonstrate the advancement of these technologies compared to standard commercially available products. These components will be integrated to optimize flexibility in demand side energy management through load shifting, solar PV self-consumption, emergency back-up, demand response, and ancillary grid services. The proposed system will be able to autonomously meet demand response and energy management requests while critical loads at the building are maintained, minimizing operational impacts. It will also realize energy and demand charge cost savings to the building owner and tenants.

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

This project integrates BESS and PV technology with advanced control algorithms and smart inverter autonomous functions. The solar+ system uses high efficiency solar panels that are DC coupled with Li-ion BESS and demonstrates various smart inverter functions to provide autonomous grid services and energy management practices under a variety of operational conditions. The team is assessing the impact smart inverter-provided grid

services and solar + storage operation have on each other. The project provides BESS and PV technology integrated with an energy management system to support diurnal energy loads. This project implements utility-initiated demand response functions and creates an architecture that allows expansion to future power regulation and potential wholesale market participation.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Distribution Resources Plans (AB 327): R.14-08-013 Smart Inverter: D.14-12-035 (in R.11-09-011) Demand Response (DR): R.13-09-011 Net energy metering: R.14-07-002 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1c, 1d, 1e, 1g, 1h, 2a, 3d, 3f, 3h, 5a

Lower Costs: This project uses PV generation integrated with BESS to manage energy use through load shifting and solar PV self-consumption. The integration of proposed energy management system components will reduce peak energy demand by shifting building and community loads. The reduction of peak energy use will reduce the costs to procure additional energy during periods of peak demand and lower consumer's energy bills. For example, the project site, a low-income/affordable housing facility, is estimated to receive an energy cost savings of $262,800 and a peak demand charge reduction of $190,507 over a ten year period. These savings will transfer to tenants as an electricity bill reduction.

Greater Reliability: This project uses PV generation integrated with BESS to manage energy use through load shifting, emergency back-up, demand response, and ancillary grid services. The integration of proposed energy management system components will reduce peak energy demand by using a BESS to shift building and community loads. The project is scalable in both size and quantity. Therefore, this effort will demonstrate the commercial feasibility to deploy many MWh of dispatchable energy integrated in a PV/BESS configuration with smart inverters.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$332,995

EPIC Funds Encumbered:

$2,110,657

EPIC Funds Spent:

$220,813

Match Partner and Funding Split:

LINC Housing Corporation: $80,000 (3.2 %)

Regents of the University of California, Riverside Campus: $265,259 (10.5 %)

EnSync Energy Systems: $46,750 (1.9 %)

EnerBlü: $19,500 (0.8 %)

Match Funding:

$411,509

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

LINC Housing successfully received approved building permits for the Long Beach site in March 2019. As a result, the Energy Commission lifted a Stop Work Order in April, 2019. LINC Housing began site construction in April 2019. UC Riverside submitted the draft Measurement and Verification Plan in September 2019 and the Energy Management System Software Development Report in October 2019.

Project Name: EPC-16-079 - Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/30/2017 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S6: Advance the Use of Smart Inverters as a Tool to Manage Areas with High Penetrations of PV.

Issue:

California Rule 21 was revised to include autonomous device control, data communication, and dynamic electrical control functions for smart inverters. A number of additional functions with the potential to substantially increase the grid's solar hosting capacity are deferred to the third phase, the timeline for which is uncertain. Phase III includes advanced functions that affect the real power produced by solar PV systems. There are both technical and economic questions that must be answered before these capabilities are to come into use.

Project Description:

This project will comprehensively evaluate the smart inverter Phase III functions. The process includes computer modeling of California distribution circuits for economic analysis, implementation of Phase III functions in multiple inverter brands, laboratory testing, and field pilot testing. An economic analysis will build on the technical findings from the computer modeling, identifying the impact to the asset owner, performing an economic valuation of these impacts, and providing guidance regarding potential compensation. A comprehensive cyber security assessment of the communication system will be performed and key public infrastructure will be established to support the cyber security needs in California.

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

This project will help overcome three major barriers to achieving the state's energy goals by: 1) proving that CA Rule 21 Phase III functions can be deployed feasibly, safely and predictably via standardization; 2) demonstrating that grid penetration levels can be increased by 25% or more via use of the Phase III advanced control functions; and 3) enabling secure, scalable and affordable cyber security infrastructure that can make the grid safer and more reliable.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Smart Inverter: D.14-12-035 (in R.11-09-011)

Applicable Metrics: CPUC Metrics- 1a, 1b, 5a, 5b, 5f, 5g

Greater Reliability: This project delivers standardized DER control functions that minimize and mitigate reverse power flows, voltage sags/dips, and other conditions that degrade grid stability and DER performance, thus increasing grid reliability and increasing the availability of access to solar energy.

Increase Safety: The standardized methodology for demonstrating compliance to Rule 21 Phase III requirements eliminates the variability implied by proprietary solutions and enables dynamic electrical control functions to be deployed safely at scale. The availability of cyber security best practices and a public key infrastructure ensures that common security pitfalls are avoided as compliant systems are deployed in the field.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$601,394

EPIC Funds Encumbered:

$2,935,822

EPIC Funds Spent:

$1,353,602

Match Partner and Funding Split:

SunSpec Alliance: $177,502 (3.9 %)

Sunrun: $1,102,122 (24.0 %)

Electric Power Research Institute, Inc.: $379,453 (8.3 %)

Match Funding:

$1,659,077

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

31 out of 35 bidders

Rank of Selected Applicant/ Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-16-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team continued the evaluation of two commercial smart inverters for Phase III compliance. The lab test at the University of California, San Diego (UCSD) was also leveraged to conduct cyber security testing (penetration testing). The test results were aimed at providing guidelines to California's DER stakeholders about safe and secure deployment of smart inverter communications. A proof of concept for cyber secure communications was established, 50 residential customers were recruited for the field demonstration of Rule 21 Phase III functions, and communication and control systems to update Phase III functions was successfully established.

Project Name: EPC-17-001 - Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions

Recipient/Contractor: Taylor Engineering, LLC

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/31/2017 to 12/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Typically, energy upgrade efforts focus on equipment replacement, which often have high costs. Updating the controls for existing systems to operate more efficiently presents a prime opportunity to achieve cost-effective savings. However, the current upgrade model presents a barrier for building owners and operators to effectively scale installation of advanced controls due to high transaction costs and the need for custom analysis and programming. This project aims to demonstrate large-scale HVAC and lighting control upgrades across a portfolio of building types that achieve energy savings while reducing transaction costs.

Project Description:

This project optimizes and simplifies control upgrades (HVAC and lighting) to demonstrate energy savings while also improving occupant comfort by using automated fault detection and diagnostics, continuous commissioning, and advanced measurement and verification procedures. The team will use the results to develop recommendations for strategies, tools, and initiatives to address market barriers and promote large scale market adoption.

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

This project will help achieve the State's energy goals by scaling up the market adoption of control retrofits that result in significant energy savings in commercial buildings. The successful demonstration of scalable, plug-and-play integrated packages of HVAC and lighting controls will allow commercial building owners and operators to maximize energy savings across large portfolios of buildings while reducing transaction costs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: Deploying a simplified approach to achieving sustained operational savings of HVAC and lighting can reduce costs for building owners and operators and has the potential to increase market adoption. In addition, integrating measures into single installations can yield upwards of 20% energy savings and can reduce overall project costs and payback periods.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$934,507

EPIC Funds Encumbered:

$2,966,716

EPIC Funds Spent:

$1,505,533

Match Partner and Funding Split:

Kaiser Permanente Medical Center: $2,300,000 (40.1 %)

Enlighted Inc.: $246,750 (4.3 %)

KGS Buildings: $25,000 (0.4 %)

Delos: $57,000 (1.0 %)

Alerton: $15,000 (0.3 %)

Trane U.S., Inc.: $15,000 (0.3 %)

Automated Logic Corporation: $30,000 (0.5 %)

Siemens Corporation, Corporate Technology: $10,000 (0.2 %)

United States Department of Energy: $75,000 (1.3 %)

Match Funding:

$2,773,750

Leverage Contributors:

CalRecycle: $4,000,000

California Alternative Energy and Advanced Transportation Financing Authority: $600,000

Leveraged Funds:

$4,600,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 2: 13 out of 15 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Progress in 2019 includes completing installations at all demonstration sites, commissioning installed systems, and beginning to collect data. The project team also conducted a critical project review meeting and gathered stakeholder feedback through a second technical advisory meeting.

Project Name: EPC-17-002 - Scaling Solar+ for Small and Medium Commercial Buildings

Recipient/Contractor: Humboldt State University Sponsored Programs Foundation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/17/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Although a range of distributed energy resources (DERs) are being designed to power and support the fast changing electric grid, these DERs are often procured and operated separately. Without coordination between them, there are missed opportunities to reduce the soft costs of deployment and better support bulk power and distribution system operations. Integration technology elements appropriate for small-to-medium sized commercial buildings (SMB) are not commercially available, making it too costly to effectively deploy smart, integrated DERs.

Project Description:

This project is developing standardized components for a Solar+ system designed specifically for the SMB sector. The research team is designing, implementing, operating, and evaluating a Solar+ system in a pilot scale application at a convenience store. The project is designed to innovate across three key priority areas necessary for technology scale-up: hardware design guidelines, integration software, and site targeting. Filling these knowledge gaps will help move the deployment of Solar+ technologies forward, thereby bringing substantial benefit to individual building owners, as well as opening opportunities to provide service to the broader distribution and bulk power systems. This project focuses on the convenience store/fueling station SMB sector, but lessons learned and products developed can be transferred to other SMB sectors.

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

This project is integrating DERs, including energy storage, and controllable loads to increase the value of Solar+ systems in the SMB sector. Optimized relative sizing of batteries to PV and flexible operations from model-predictive control (MPC)-enabled building automation will demonstrate how investment in an integrated system can save costs and create efficiency compared to standalone PV and storage. The project will develop and demonstrate an open-source MPC algorithm. Improved hardware-software interfaces will integrate the solar PV system with localized energy storage and MPC-

improved load control systems. This will allow SMB owners to optimize the benefits of distributed solar and approach net-zero energy buildings while also supporting the larger grid power system.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Self-Generation Incentive Program: R.12-11-005 Energy storage: R.15-03-011 (closed) Distribution Resources Plans (AB 327): R.14-08-013 Smart Inverter: D.14-12-035 (in R.11-09-011) Demand Response (DR): R.13-09-011 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1c, 1e, 1f, 1h, 1i, 2a, 3d, 3h, 5a, 5f

Lower Costs: This project will reduce onsite energy demands and peak loads, resulting in customer bill savings. For example, the estimated site benefits include energy and demand charge savings of $0.20 per watt of PV per year, along with payments for demand response for the distribution system and build power system of $0.20 per watt of PV per year. Without a coordinated effort to install solar + storage as a package, the commercial cost of such systems would be about $9 per watt of PV. This project will develop hardware design guidelines, integration software, and a site targeting toolkit to reduce the costs of installing solar PV, battery energy storage, and smart inverter equipment by about 33%.

Greater Reliability: This project will expand the ability to provide power for critical services (e.g., fuel dispensing and refrigeration loads) in times of emergency when the utility grid is disabled (e.g., due to weather-related disaster). These project benefits will accrue both to the site host and to the local distribution grid. However, the greatest benefits from the project will likely come from amplification effects through the improved ability to promote smart deployment of Solar+ systems at scale throughout California.

Environmental Benefits: Preliminary calculations indicate significant DER capacity could be deployed through the framework and systems this project is developing. On first order, if each of the 12,000 convenience stores in California were to install or procure the equivalent of 50 kW in PV capacity, this would result in 600 MW of additional statewide capacity that generates 880 GWh annually. If there were no commensurate reduction in the RPS compliance requirements (because the generation would be behind the meter) this would represent accelerated progress on greenhouse gas emissions reductions, saving 300,000 tonnes CO2e per year.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$413,443

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$871,666

Match Partner and Funding Split:

Humboldt State University Sponsored Programs Foundation: $41,577 (2.3 %)

Serraga Energy, LLC at Blue Lake Rancheria: $258,665 (14.0 %)

Tesla Motors, Inc.: $25,000 (1.4 %)

Southern California Edison: $20,000 (1.1 %)

Match Funding:

$345,242

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

31 out of 35 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The solar + storage system has finished commissioning as of November 2019. Humboldt has conducted surveys of gas station / convenience stores across California to verify similar characteristics between sites and submitted a Convenience Store Survey Memo. Humboldt has also submitted a Cost Estimation Framework Memo that estimates the cost of installing similar solar + storage systems at other gas station / convenience stores, and forecasts how capital costs may decline over a 12-year period. Lawrence Berkeley National Labs has completed the development of the open-source model-predictive control (MPC) and submitted an MPC software report.

Project Name: EPC-17-003 - Developing a Comprehensive, System-Wide Forecasting to Support High-Penetration Solar

Recipient/Contractor: Clean Power Research, L.L.C.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/1/2017 to 6/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

California experiences a wide range of meteorological phenomena, including coastal and valley fog, monsoon events, and temperature inversion and smog events. These phenomena impact the reliability of both satellite-based and Numerical Weather Prediction (NWP) forecast models due to the challenge of predicting cloud formation and dissipation during these conditions. This weather-based uncertainty translates into PV simulation uncertainty in which electric grid operators increasingly rely upon forecast of PV production in their dispatch of operating resources. Forecast inaccuracies cost California millions of dollars annually and result in the unnecessary curtailment of renewable generation.

Project Description:

This project is developing, testing, and validating a high-accuracy forecast for photovoltaic (PV) generation across California and coordinating with the California Independent System Operator (CAISO) on incorporating the results into its PV forecasting operation. The comprehensive forecast includes both behind-the-meter (BTM) and in-front-of-the meter scale PV systems. The project is quantifying the costs and benefits of these improvements. The researchers are using mid-term DER adoption forecasts adapted from the investor-owned utility distribution resource plans to project the distribution of DERs through 2050. The team is also providing CAISO with the steps required to incorporate the statistically-adjusted BTM solar PV generation estimates into CAISO's Reconstituted Load approach.

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

This project is advancing the state of PV forecasting in California by improving the accuracy of solar irradiance and PV forecasts, particularly rooftop solar, which was not currently well-understood. Participants in the Energy Commission's January 2017 forecasting workshop identified the lack of visibility into DER impacts on net load as a major barrier to generating accurate forecasts. Forecast inaccuracies cost California

millions of dollars annually and result in the unnecessary curtailment of renewable generation.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 2a, 3a, 5c

Lower Costs: This project implemented and improved PV production forecasts that will enable CAISO to reduce net load forecast uncertainty, resulting in cost savings to California. The cost of procuring both spinning and non-spinning reserve resources will experience a decrease. CPR developed methods to estimate the savings from improved CAISO forecasts. The "Resource Adequacy" method estimates the capital cost of gas generation reserve capacity necessary to mitigate 90% of the forecast uncertainty. Using this method, CPR estimates that the forecasting methods developed in this project will save California $176 million over the next 30 years.

Greater Reliability: This project provided CAISO with an improved PV production forecast to increase electric power system reliability across California. The uncertainty of PV generation imparts costs to the California ratepayer, because the CAISO must carry spinning and non-spinning reserve resources to accommodate this uncertainty. It was demonstrated that increasing the forecast accuracy narrows the error distribution and therefore decreases the reserve requirement and costs. The project provided knowledge to grid operator and California decision-makers to help the state plan for increased adoption of DERs while maintaining reliability standards by examining the impacts of DER adoption on forecast accuracy.

Environmental Benefits: Assuming that the deferred reserves are reflective of the average California energy mix, the increased forecasts that defer 57 MW of reserves for the entire year corresponds to roughly 500 GWh of displaced electricity and roughly 166,000 Teq (Tons-equivalent) of CO2 using the emissions factor of 0.331 kg/kWh CO2.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$261,080

EPIC Funds Encumbered:

$750,000

EPIC Funds Spent:

$663,876

Match Partner and Funding Split:

State University of New York at Albany: $20,000 (1.9 %)

Clean Power Research, L.L.C.: $300,000 (28.0 %)

Match Funding:

$320,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 5: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Update:

The project developed several forecast improvements by advancing methods for identifying low cloud layer front line motion and PV forecast uncertainty. The researchers also refined the Reconstituted Load Model, performed under a prior EPIC agreement, to account for systematic day-ahead forecast errors due to the misspecification of the solar PV generation impact. The study demonstrated that the accuracy of the existing Reconstituted Load models can be improved by replacing the unadjusted solar PV generation with statistically-adjusted solar PV generation data. The day-ahead forecast of the morning/evening, afternoon, and dawn hours are expected to have accuracy gains of 10%, 3%, and 8%, respectively. CAISO started running the Reconstituted Load model alongside their other production models to further inform day ahead load forecasting.

Project Name: EPC-17-004 - Enhanced Modeling Tools to Maximize Solar + Storage Benefits

Recipient/Contractor: Energy and Environmental Economics, Inc. (E3)

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/18/2017 to 3/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Customer adoption of PV, storage, and other distributed energy resources (DERs) is set to substantially increase in California as technology costs decrease, new products are brought to market, and the relationship between customer and utility evolves. DERs could have very different costs to ratepayers depending on how customers are incentivized to use them. If the incentivized use of DERs by customers through their tariffs or programs is not aligned with the needs of the grid, increased DER adoption could be very costly to ratepayers.

Project Description:

This research has developed a solar + storage optimization tool to evaluate the dispatch, operations, and value proposition for integrated solar + storage systems. The tool is capable of evaluating distributed solar with storage and an array of advanced controls and dispatchable DER technologies, and it evaluates optimal dispatch for a wide range of customer programs and incentives. The tool is also designed to integrate into the California Public Utility Commission (CPUC) Distributed Resource Planning proceeding and could be used in that proceeding's Distribution Investment Deferral Framework (DIDF).

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

This project developed a modeling tool, with feedback from Technical Advisory Committee members, that will enhance the existing Local Net Benefits Analysis tool developed by the project team under the CPUC's Distributed Resource Planning proceeding. The modeling tool is capable of simulating the operations of DERs under different tariff and program designs and determining the new designs that align the best uses of DERs for customers and for the grid and can maximize the benefits of DERs for ratepayers. The current planning tools do not consider how different tariff and program designs will affect DER locations and adoption rates that will affect system reliability and cost.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 2a, 3b

Lower Costs: An estimated $420 million in distribution capital expenditures are driven by peak load growth and are potentially deferrable by targeted deployment of DERs. Assuming deferral of 10% of those costs ($42 million) for 3 years and a utility weighted average cost of capital of 7.9%, the cost reduction for ratepayers is $9 million for 2017 and $34 million over 5 years. The project will enable DER deployment targeted to areas with highest deferral value. Conservatively estimating that this doubles the deferral value (e.g. from $50 to $100/kW-Yr.) for 5% of the deferral opportunities, the annual ratepayer savings are $21 million.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$457,030

EPIC Funds Encumbered:

$987,379

EPIC Funds Spent:

$918,234

Match Partner and Funding Split:

Southern California Edison: $50,000 (4.6 %)

Energy and Environmental Economics, Inc. (E3): $17,150 (1.6 %)

Starboard Energy Advisors, LLC: $35,000 (3.2 %)

Match Funding:

$102,150

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The public release of the Solar + Storage Modeling Tool was completed in June 2019. E3 held two public workshops to introduce the tool. The first workshop in June, 2019, provided an introduction to the tool, reviewed the user guide and functionalities, and discussed how the tool can simulate and determine which design will maximize the benefits of DERs to ratepayers. The following workshop in August, 2019, provided an in-depth training for stakeholders interested in using the tool. E3 guided stakeholders through the process of creating inputs, analyzing the cases, and viewing the final results.There are discussions on using this tool in the Distribution Investment Deferral Framework process to target the cost-effective DER to those locations that provide the highest utility and ratepayer benefits.

Project Name: EPC-17-005 - Integrating Building-Scale Solar + Storage Advanced Technologies Maximizing Value to Customer and the Distribution Grid

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 12/13/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Regulatory and economic factors in California have created accelerated penetration of rooftop photovoltaic (PV) in the small commercial segment, benefitting facility managers in energy savings while helping to achieve California's renewable goals. However, uncontrolled and uncoordinated renewable generation creates issues with stability and reliability of the distribution grid. Given that implementation of PV, storage, and energy efficiency and energy management systems (EMS) technologies are typically siloed, synergistic benefits are difficult to realize. An integrated Distributed Energy Resource (DER) management approach is needed to balance commercial customer and grid requirements.

Project Description:

This project assesses the performance and benefits of integrated solar photovoltaic and storage along with advanced energy efficiency, demand response, and distributed energy resource management technologies in a commercial building setting. The goal is to leverage the synergies of integrated and controllable components to improve distribution grid stability and reliability while also enabling the commercial customer to reduce both capital costs and operational and management costs for optimal value.

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

For California to achieve its long-term greenhouse gas reduction goals, there is a greater need for flexibility at all levels of grid operations. This project is demonstrating a suite of DER technologies, including solar + storage, with the capability for active and reliable control of customer-owned loads and resources to 1) reduce the building owner's energy bill and 2) reduce the need to build new transmission and distribution infrastructure that is often required to compensate for high loads and customer-side generation.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Distribution Resources Plans (AB 327): R.14-08-013 Net energy metering: R.14-07-002 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1h

Lower Costs: Synergistic integration with storage further reduces grid stress and expensive peak generation at ramp-up time, improves distribution capacity utilization, and reduces stress to prolong asset life and reduce costs of distribution system upgrades. Total lifecycle cost (capital cost, installation, and operations and maintenance) for a behind the meter solar + storage system is expected to be reduced by up to 10% through energy system integration.

Greater Reliability: This project reduces distribution system stress through better dispatchability and improves management of both over-generation and 'ramp-up' periods through flexible load and storage management.

Environmental Benefits: Solar generation helps reduce greenhouse gas and air emissions associated with grid power, particularly when off-setting peak power. This project will enable the cost-effective integration of increased penetrations of solar generation.

Consumer Appeal: Better integration of customer preferences and operational priorities with grid preferences. Cost-effective implementation reduces both acquisition costs and O&M costs.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$360,079

EPIC Funds Encumbered:

$1,491,764

EPIC Funds Spent:

$300,415

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $271,090 (15.4 %)

Match Funding:

$271,090

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

31 out of 35 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

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

Patent application for novel daylighting panels. Smart Software Algorithms to charge Electric Vehicles from the grid or battery system based on time of day and utility rates. Smart software algorithms to monitor, control and visualize energy and power flows from renewable power sources, distributed energy storage system and other grid generation and transmission assets.

Update:

The project site moved to the San Francisco Bay Area Council of the Boy Scouts of America, located in a disadvantaged community in San Leandro. The project team completed installation of circuit-level monitoring equipment and has begun collecting baseline energy performance data of the major loads in the building. They have completed the following deliverables: the DER-integrated design document, the test plan, the requirements definition document, the site readiness document, and the measurement and verification plan. The project team is currently finalizing the following deliverables: the energy data warehouse report, the software design document, and the tariff effectiveness methodology document. Completion of construction of the integrated DER system is expected by the end of 2019.

Project Name: EPC-17-006 - Development, Implementation, and Integration of a Holistic Solar Forecasting System for California

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 10/5/2017 to 6/28/2020

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

Successful integration of renewable resources into power system operations will require the ability to forecast the output of these resources in timeframes from less than an hour to days ahead. Fog and stratus affect solar irradiance in California throughout the year, and shortcomings in predicting fog and stratus dissipation currently constrain the accuracy and confidence of short-term solar irradiance forecasts. The value of using improved forecasts is still not well understood by grid operators and utilities due to the difficulty of assessing return on investment for an improved forecasting system particularly for deploying instruments to improve the data used in forecasting models.

Project Description:

The project develops an improved forecasting system for solar irradiance in California, with a particular focus on fog and stratus conditions, through targeted deployment of instrumentation. The improved forecasts will be integrated into operational tools for use by the California Independent System Operator (CAISO) and utilities. This project utilizes a targeted instrumentation network, consisting of existing and new sensors, to improve the models used for forecasting fog and stratus conditions. The Recipient will design and deploy this network with the aim of improving the forecasts that are most important to CAISO and utility operations.

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

The use of an advanced network of existing and new instrumentation to inform numerical weather and statistical model improvements will significantly improve the current state of solar forecast modeling in California. The holistic forecasts produced will showcase a combination of various aspects of the weather forecast value chain, not previously demonstrated, linking observation systems and advanced physical and statistical modeling for solar forecasting. The project's focus on fog and marine layer forecasts, which are traditionally challenging to predict, will improve solar energy forecasting and contribute to increased PV penetration.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1b, 2a

Lower Costs: Improved forecasts help reduce operating costs by improved commitment and dispatch of generating resources, reductions in solar power curtailment, and more optimal procurement of resources for Investor Owned Utilities (IOUs).

Greater Reliability: Improved forecasts support the advancement of reliability of renewable energy by reducing uncertainties in generation across the CAISO system, improving voltage control on distribution systems, and ensuring that utilities can perform transmission and distribution switching.

Increase Safety: Improved forecasts can help maintain safety at the distribution and transmission level, improve switching operations required for DER management, and inform new smart grid devices that can manage voltage.

Economic Development: Improved forecasts of marine layer and fog conditions have the potential to improve the efficiency of generation dispatch, reduce the need for operating reserves to manage forecast error and maintain or increase reliability while integrating increased levels of renewables. A uniform improvement of 20% for day-ahead and four-hour-ahead forecast horizons can reduce system wide production costs by up to 0.4% at penetration levels of approximately 20% energy.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$365,395

EPIC Funds Encumbered:

$749,740

EPIC Funds Spent:

$113,581

Match Partner and Funding Split:

AWS Truepower, LLC: $177,229 (16.5 %)

Sonoma Technology, Inc.: $83,000 (7.7 %)

Electric Power Research Institute, Inc.: $64,601 (6.0 %)

Match Funding:

$324,830

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 5: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The field data campaign included successful deployment of new sensors and integration of existing sensor networks. Unique data were collected during numerous summer and winter stratus episodes during 2018 and early 2019. The project team succeeded in using data storage solutions to facilitate real-time and historical data sharing. The team is investigating several research questions related to improving statistics-based solar radiation forecasting, such as on the role of the atmospheric boundary layer and which sensors provide the most added value in improving forecasts. The team developed machine-learning models to predict cloudiness and solar irradiance at Fremont for several forecast horizons, from 15 minutes to 2 hours, involving different independent variables available from the sensor data.

Project Name: EPC-17-007 - Integrated Community Solar and Storage at a Low Income Mobile Home Park

Recipient/Contractor: Center for Sustainable Energy

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/13/2017 to 12/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Distributed solar photovoltaic (PV) systems will continue to be deployed to meet California's GHG reduction and renewable energy goals, but they can lead to daytime grid oversupply and difficulty meeting evening demand. Energy storage can shift PV generation from mid-day to evening peak, but rates do not adequately incentivize mid-day storage charging periods. Adding storage to existing solar PV installations requires duplication of permitting, installation, and commissioning efforts and costs. In addition, an integrated community-scale solar + storage solution has not been adequately demonstrated in mobile home parks, which host over 360,000 mobile homes in California.

Project Description:

The Center for Sustainable Energy (CSE) planned to apply high efficiency solar and storage technologies to create an integrated community solar and storage energy system at a low income mobile home park. If this project had proceeded as planned, it would have illuminated operational strategies for solar and storage to provide clear value propositions to end-use customers with existing tariff structures and demonstrated alternate structures and additional value streams that could have increased the value of solar and storage to the end customer while better achieving distribution system operational goals.

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

This project planned to design, install, and evaluate integrated high-efficiency solar panels with energy storage batteries, along with low-cost control hardware to demonstrate the impact of an integrated community solar and energy storage system in a low-income mobile home community. The project was designed to demonstrate the impact of an integrated community solar and energy storage system in a low-income community mobile home community to reduce net energy consumption and energy bills. A demonstration of a scalable solar and storage solution that provides clear value to

residents is necessary to spur adoption of these clean energy technologies in the underserved mobile home residential sector.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Net energy metering: R.14-07-002 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 3h

Lower Costs: The primary application of the solar PV and energy storage system would have been to lower energy costs, by approximately 37%, for the individual tenants within the mobile home park. Additionally, by providing potential locational benefits such as reducing congestion on the distribution feeder or increasing the integration capacity of the circuit, the grid would function more efficiently, potentially deferring or offsetting grid transformer or line upgrades. Shifting excess solar PV generation from the middle of the day to evening residential peak hours would reduce the need to deploy more expensive peaker plants.

Greater Reliability: The project was strategically sited in a distribution area identified by PG&E for needing capacity upgrades due to potential thermal overloads and voltage concerns. Storage integrated with solar PV on the distribution system can increase system reliability through services such as local overload relief, renewable integration on circuits with high penetration of intermittent generation, and local customer back-up.

Environmental Benefits: If this project had proceeded as planned, it could have led to reductions in greenhouse gas and air pollutant emissions through reduced energy consumption and generation. Deployed at 5% of mobile home and multifamily dwellings across the state by 2025, community-scale solar PV and energy storage operated as proposed could have reduced annual energy generation needs, including peak-demand, by 800 MWh. This reduced energy consumption would have resulted in an estimated reduction of roughly 505,000 metric tons of CO2 annually, with concurrent reductions in both NOx (criteria pollutant) and methane (GHG) emissions.

Consumer Appeal: The integrated suite of solar PV, energy storage, and smart controls was anticipated to reduce annual energy usage by 32%, bringing total utility bills down by approximately 37%, which would have been substantial considering the energy discounts the park already receives through the California Alternate Rates for Energy (CARE) program. The same configuration and use cases piloted in this project could have been replicated at other multifamily dwellings as well.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$499,016

EPIC Funds Encumbered:

$2,005,923

EPIC Funds Spent:

$35,805

Match Partner and Funding Split:

Resident Owned Parks, Inc.: $340,905 (14.5 %)

Match Funding:

$340,905

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

31 out of 35 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Grantee has identified the following as pre-existing project relevant IP:

1) Center for Sustainable Energy Name and Logo

2) Horizon Solar Power Logo

3) Kisensum Energy Storage Control Software

Update:

CSE was placed under a stop work order in July 2018. The stop work order was originally placed because the major subcontractor Horizon Solar Power (HSP) found that it did not budget for prevailing wage and was not allowed to increase labor rates. After an unsuccessful attempt to replace HSP with another subcontractor through a bidding process, CSE finally returned to HSP in January 2019 and worked out a solution by moving the prevailing wage positions to another subcontractor beneath HSP. CSE and HSP were working out changes to the budget when the site host dropped out of the project in May 2019. CSE identified a potential replacement site in July, but by November 2019, the site owner was unable to commit to hosting the project. Staff recommended mutual termination of the project in November 2019.

Project Name: EPC-17-008 - Empowering Energy Efficiency in Existing Big-Box Retail/ Grocery Stores

Recipient/Contractor: Center for Sustainable Energy

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/1/2017 to 1/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

California Senate Bill 350 aims to double statewide electricity end use savings from energy efficiency and conservation measures by 2030. Meeting this aggressive target will require the commercial building industry to install holistic energy efficiency technology packages that are emerging, pre-commercial products. According to the 2013 Navigant California Potential and Goals Study, aging, existing commercial buildings, particularly in inland communities, present the greatest energy savings potential. Emerging technologies such as retrofit RTU motors, DC lighting, direct-evaporative cooling, and a cloud-based control platform will demonstrate 20% onsite energy reduction.

Project Description:

This project demonstrates the impact of an integrated suite of pre-commercial energy efficiency technologies in a large, existing, retail building located near a disadvantaged community. One of the technologies that comprise the installation package includes a novel supervisory controller to provide system-wide optimization, to reduce electricity consumption across numerous building subsystems, including lighting, refrigeration, and heating, ventilation, and air-conditioning. This could enable site electricity savings of greater than 20%.

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

This project demonstrates how pre-commercial energy efficient technologies can deliver cost-effective, deep electric savings in a big-box retail environment, while also showcasing the demand reduction potential of these strategies. The project team will install a holistic suite of pre-commercial technologies such as a variable speed rooftop unit (RTU) high rotor pole switched reluctance (HRPSR) retrofit motor, direct current (DC) LED technology, direct-evaporative cooling to treat RTU condenser inlet air, and a cloud-based control system that will monitor all systems and detect energy waste, equipment malfunctions, and other operational problems. These technologies have the ability to demonstrate 20% energy savings.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: The project could result in lowering on-site electricity use by 20 percent.

Greater Reliability: The project adds valuable capacity to California's electrical transmission and distribution system by reducing power consumption of packaged HVAC systems which are disproportionately responsible for critical capacity shortfalls on the grid. The demand response controls will maximize the use of variable renewable resources, such as the site's PV system.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$544,329

EPIC Funds Encumbered:

$2,824,685

EPIC Funds Spent:

$640,965

Match Partner and Funding Split:

Walmart: $250,000 (7.0 %)

Southern California Edison: $100,000 (2.8 %)

Software Motor Corporation: $79,704 (2.2 %)

LumaStream LLC: $191,073 (5.3 %)

TRC Engineers, Inc.: $139,207 (3.9 %)

Match Funding:

$759,984

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

phase 2: 13 out of 15 bidders

Rank of Selected Applicant/ Bidder:

Phase 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the team identified LumaStream, LLC as the new DC lighting solution replacing Robert Bosch who dropped from the agreement. LumaStream will demonstrate a low-voltage, DC lighting solution that provides opportunities for simplified installation, more efficient centralized LED drivers and low energy consumption per lumen than conventional LED lighting installations. The team is modeling this solution with the current retrofit portfolio to see how much energy will be saved at the site. The team is procuring and installing the technologies for the demonstration site.

Project Name: EPC-17-009 - Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California)

Recipient/Contractor: Willdan Energy Solutions

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/1/2017 to 3/28/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Much of California's existing buildings stock is old and high-energy consuming. An estimated 50% of the state's existing buildings were built before California's Building Energy Efficiency Standards went into effect in 1978. Commercial facilities consume 37% of the state's electricity, more than any other sector. Yet there remains significant energy reduction potential for this sector. Adoption of comprehensive energy efficiency packages has been limited. Market barriers such as lack of stakeholder knowledge, fear of early adoption, and the high cost of emerging technologies means significant energy savings opportunities remain.

Project Description:

This project demonstrates three innovative bundles of pre-commercial technologies. The technology bundles were strategically developed through a systems-level approach to address the most energy-intensive areas in commercial buildings. These include: (1) Chilled Water Plants: Optimized all-variable-speed chilled-water (CHW) plants utilizing alternative refrigerant chillers. (2) Office and Exterior Space LED fixtures with integrated advanced controls, advanced building management system (BMS), and plug load controls controllable for demand response (DR), and off-grid, exterior, LED lighting in the parking lot, and lastly (3) Advanced laboratory ventilation, fume hood exhaust, and direct current (DC) lighting systems.

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

The demonstration project offers an innovative approach applicable to a range of commercial buildings. This strategy will accelerate adoption of energy savings technologies, contributing to reaching the state's energy efficiency and GHG reduction goals. By demonstrating this comprehensive approach in a real-world application this research has the potential to lead to further scale up and adoption of similar technology packages in other government and commercial buildings.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h, 3b

Lower Costs: Energy savings achieved through implementation of these technologies could generate cost savings for building owners and operators. It is projected that these technologies will save an estimated 20% of building energy consumption. Future adopters will benefit from lower costs associated with economies of scale as production increases.

Economic Development: Large-scale adoption of these technologies will promote industry growth through increased manufacturing and construction, spurring new growth and leading to further investment in research and development of additional new technologies.

Environmental Benefits: In addition to GHG emission (CO2) reductions associated with the energy savings of the project, the project includes chillers that utilize low global warming potential (GWP) alternative refrigerant that contain no stratospheric ozone depletion compounds. These refrigerants are in alignment with the Montreal Protocol Kigali Agreement to phase out high GWP refrigerants. It also supports the California Air Resources Board target to reduce short lived climate pollutants.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$875,037

EPIC Funds Encumbered:

$3,994,256

EPIC Funds Spent:

$506,188

Match Partner and Funding Split:

ASWB Engineering: $5,330 (0.1 %)

Aris Wind: $33,250 (0.5 %)

Trane U.S., Inc.: $50,000 (0.8 %)

Willdan Energy Solutions: $2,293,645 (36.0 %)

Match Funding:

$2,382,225

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 2: 13 out of 15 bidders

Rank of Selected Applicant / Bidder:

Phase 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project continues to progress as expected. Both chillers and cooling tower retrofits will be complete by March 2020. Staff is coordinating a site visit for Spring of 2020.

Project Name: EPC-17-010 - Integrated Heat and Moisture Calculation Tool for Building Envelopes

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/14/2017 to 12/1/2020

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Moisture can degrade both the durability and thermal performance of buildings. This project designs software to identify thermal and moisture interactions during building envelope design.

Project Description:

The project develops software to enable building professionals to design better buildings, resistant to moisture accumulation issues and moisture-related damage. The goal is to develop tools that can be integrated with EnergyPlus/OpenStudio or similar design tools to reduce the time to specify, implement and verify the proper operation of control sequences. The project will integrate and build on existing software to use heat and moisture modeling in buildings that are exposed to natural climate conditions. The new software tool will offer will enable building design engineers to use energy-efficient ASHRAE-developed or custom control sequences for commercial buildings to verify correct implementation.

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

The cost-effective modeling tool will enable improved envelope designs for new construction and retrofit applications, thus increasing building energy efficiency. As this project is jointly funded with the US Department of Energy, the developed tools have the potential to be broadly disseminated which could further the advancement of the developed software

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: The software tool could increase building envelope energy efficiency and reduce HVAC energy use by 5%.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$59,209

EPIC Funds Encumbered:

$125,000

EPIC Funds Spent:

$100,000

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

Lawrence Berkeley National Laboratory: $1,250,000

WESTLab: $45,000

The Regents of the University of California; Center for Forestry/Forest Products Laboratory: $8,000

Owens Corning: $24,000

SmithGroup: $18,000

British Columbia Institute of Technology: $14,175

WinBuild: $16,000

Leveraged Funds:

$1,375,175

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team is working on the testing and verification of the software tool THERMM. The work being performed is to add user interface features to make THERMM more user friendly. They are fixing bugs and continue to work on connecting the software and the graphic user interface. Once connected, they will being the internal testing and they expect the outside testing can start in January/February. Testing is expected to be completed by June 2020.

Project Name: EPC-17-011 - Demonstration of an Innovative, Community-Scale, Organic Waste-to-Energy Facility

Recipient/Contractor: HZIU Kompogas SLO Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/9/2017 to 9/30/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

Newly adopted state goals have called for increased production of renewable energy, increased waste diversion from landfills, and a reduction of short-lived climate pollutant emissions. Increased deployment of anaerobic digester systems can help meet all of these goals by producing renewable energy, diverting organic waste from landfills, and reducing associated short-lived climate pollutant emissions. However, anaerobic digester systems tend to be logistically complicated, technologically complex, and prohibitively expensive. There is therefore a need to demonstrate and deploy cost-effective anaerobic digester systems in local communities.

Project Description:

The goal of the project is to construct and demonstrate operation of an innovative, state-of-the-art anaerobic digestion facility for converting organic waste into renewable electricity in San Luis Obispo County. The facility is the first of its kind in dry digester technology to be installed in the United States and is expected to process about 36,500 tons of food waste and urban waste into 6.2 million kWh per year of renewable electricity, 13,000 tons of compost, and 1.6 million gallons of liquid fertilizer leading to a host of environmental (e.g. reduction of 5,300 MT CO2e per year), economic, reliability, and safety benefits.

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

This project will benefit California ratepayers by demonstrating an innovative, state-of-the-art anaerobic digester facility. Once economical operation is proven, similar facilities can be replicated across California to provide similar benefits to other local communities.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 2a, 3a, 3b, 3g, 3h, 4a

Lower Costs: This project will demonstrate a cost-effective approach for utilities to meet their bioenergy mandates while also lowering the cost of bioenergy for electric ratepayers.

Greater Reliability: This project will produce approximately 6.2 million kWh of renewable distributed generation annually, improving local system reliability and reducing the stress on the grid.

Environmental Benefits: Diversion of organic waste from landfills will result in avoided methane and nitrous emissions, powerful short-lived climate pollutants. The project team estimates the system will result in net annual greenhouse gas emission reductions of approximately 5,300 metric tons of carbon dioxide.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$4,000,000

EPIC Funds Spent:

$2,823,377

Match Partner and Funding Split:

HZIU Kompogas SLO Inc.: $5,278,373 (56.9 %)

Match Funding:

$5,278,373

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

This project will utilize the Hitachi Zosen Innova digester system originally developed in Japan.

Update:

The project team completed construction of the anaerobic digester (AD) facility in San Luis Obispo in October 2018. The facility currently converts 700 tons of green waste and food waste per week into 465kWh of renewable electricity on average. The BioMAT PPA agreement was executed in July 2019 and facility has since been selling power to PG&E at a price 12.7 cents per kWh. In addition, the facility produces compost, and has been selling it to wineries.

Project Name: EPC-17-012 - Biomass-to-Electricity: Pilot-Scale Testing of Baseload Compared to Flexible Power

Recipient/Contractor: Taylor Energy

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/1/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

In 2016, the US Forest Service estimated the occurrence of over 102 million dead and dying trees in California's forests. This buildup of dry fuel increases the likelihood of large wildfires, which have significant negative impacts to the environment, human health, and safety. Disposal of these dead and dying trees is necessary to mitigate wildfire risk, however, it is extremely expensive and has been difficult to recover the costs. Adoption of community-scale bioenergy systems can create a sink for forest wood waste that generates renewable electricity and local revenue. There is a need to identify technologies that can cost-effectively convert forest waste biomass to energy.

Project Description:

The project tests and evaluates three different energy pathways for conversion of woody biomass to electricity. The three pathways tested with the pilot-scale gasifier system are: 1) clean fuel gas production for baseload power generation, 2) syngas to Fischer-Tropsch liquid production for storage and flexible power generation, and 3) direct bio-crude production for storage and flexible power generation. Results from the three pathways will be compared and an optimal pathway will be identified for extended testing. After performing extended testing of the optimal pathway, the technical, environmental, and economic performance of a full-scale facility will be evaluated.

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

This project will test and evaluate new biomass-to-energy pathways, which is critical to meeting several of California's energy goals and provides numerous economic, environmental, and safety benefits to California ratepayers.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

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

Lower Costs: The technology aims to significantly reduce the capital costs of biomass gasification systems, subsequently reducing the cost of renewable electricity generated. The technology is expected to provide at least a 20 percent improvement in cost-effectiveness compared to existing systems and would be capable of delivering power at $0.118/kWh for a full-scale system.

Increase Safety: Increased use of forest waste biomass can reduce the risk of catastrophic wildfires, which can have major impacts on human health and safety.

Environmental Benefits: The technology aims to produce significantly reduced criteria pollutant emissions compared to conventional biomass boiler generator systems, which will be quantified during the project. Compared to conventional natural gas power plants, this technology aims to reduce greenhouse gas emissions by 50 percent. In addition, increased utilization of forest-derived biomass may reduce wildfire damage, which produces the majority of black carbon emissions in California.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$254,980

EPIC Funds Encumbered:

$1,499,000

EPIC Funds Spent:

$1,141,799

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The technology employs "shockwave gasification". Shockwave Gasification employs pulse-detonation power to increase biomass gasification process intensity. The technology was developed, tested, and reduced to practice under a previous EISG grant program that compared gasification methodologies, using a pulse-deflagration method compared to a pulse-detonation method.

Update:

The project team has completed initial system modifications and has performed testing of the first pathway - clean fuel gas production for baseload power generation. The project team is performing system modifications required for testing of the other two pathways. The contractor has completed gas clean-up and carbon-char removal systems, while testing biomass gasification.

Project Name: EPC-17-013 - Small Scale Forest Waste Power System

Recipient/Contractor: Altex Technologies Corporation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/1/2017 to 4/30/2020

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

The risk of forest fires is very high in the semi-arid climate of California. Innovative management of woody biomass can reduce the serious risk of high severity forest fires. Forest waste material could be utilized as a renewable fuel resource to help California achieve its Renewables Portfolio Standard. However, use of forest biomass for power production has been challenging due to high costs associated with collection, pre-processing, and transportation. One of the possible solutions is an operationally reliable and affordable modular biomass power plant that can utilize this abundant resource to produce cost competitive renewable electricity.

Project Description:

This project develops a pilot-scale modular biomass power system called Altex Forest Power Technology (FORPOWER) that uses biomass from forest management as fuel to generate renewable electricity. FORPOWERis based on an indirectly-fired gas turbine technology that separates the fuel combustion products from the clean gas turbine working fluid by using a novel heat exchanger. The system uses forest slash as a renewable fuel while meeting criteria pollutant requirements, reducing greenhouse gas emissions, supporting renewable energy goals, and improving forest sustainability. FORPOWER is expected to cost-effectively convert forest slash to electric power and interconnect with the grid at distributed locations within investor-owned utility regions that are close to forest resources.

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

Integrating a low cost feedstock densification approach and innovative heat exchanger with gasifier and externally-fired gas turbine to efficiently generate electricity from forest slash will provide multiple benefits to California investor-owned utility ratepayers, including reduced power cost relative to alternative approaches, improved electric power generation reliability, reduced risk of forest fires and pollutant emissions, and improved economic development opportunities in forested regions.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) SB 1122 Bioenergy feed-in tariff: R.11-05-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

Applicable Metrics: CPUC Metrics- 1a, 2a

Lower Costs: The Altex FORPOWER uses a low-cost forest slash densification approach (developed under PIER); combines this approach with an externally-fired turbine and innovative heat exchanger that further lowers the cost of power by over 39% compared to a typical forest biomass gasifier coupled to an internal combustion engine.

Greater Reliability: A successful distributed generation technology like FORPOWER will help improve system reliability once dispersed in different locations by distributing feed in of power to the grid at multiple locations thereby reducing loads on transmission lines and substations.

Economic Development: Ten units of the scaled-up system (at 30 MW of total capacity) could provide revenue of over $20 million per year from generated electricity. Revenue from the production of power from biomass power plant operation and sales of power plant units along with collection and transport of biomass will bring economic development near forests and create jobs. Researchers estimate that 10 units would create 90 direct jobs.

Environmental Benefits: FORPOWER technology will help reduce fossil fuel use and the associated emissions of criteria pollutants and greenhouse gases. Assuming a 31% reduction in forest management costs and 50 units of the technology are deployed over 10 years, the reduction in greenhouse gas emissions could surpass one million tons per year.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$768,611

EPIC Funds Encumbered:

$1,499,994

EPIC Funds Spent:

$1,335,698

Match Partner and Funding Split:

The Avogadro Group, LLC: $7,250 (0.4 %)

Altex Technologies Corporation: $154,478 (9.3 %)

Match Funding:

$161,728

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The Altex developed process and apparatus for densification of biomass material will be used in the proposed FORPOWER system, to densify the Forest Slash Feedstock, for use in the system process.

Update:

FORPOWER densification and bioenergy modules have been built and tested. System biomass testing will continue and data will be collected. The work is progressing, but has been delayed due to a generator power output problem and a biomass feeding problem. Both problems have been corrected. System biomass testing will continue and data will be collected to determine the potential of the concept to convert forest slash into power.

Project Name: EPC-17-014 - Advanced Plug Load Controls and Management in the Educational Environment

Recipient/Contractor: Newcomb Anderson McCormick, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 11/8/2017 to 3/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Advanced Plug Load Management Device (APMD) demonstration projects have only been conducted on a small scale (<100 units). These studies have not evaluated large deployment, nor led to broad market acceptance/penetration. Many college buildings lack the ability to control plug loads. This project will deploy and evaluate ~3,500 APMD units at multiple community college districts in investor-owned utility (IOU) service territories throughout California. This project offers opportunities for cost-effective market transformation of the plug load controls for the community college market.

Project Description:

This project deploys APMD technology at approximately 3,500 computer workstations at several community colleges, and focuses on integrating the technology with facility operations to ensure that they meet the needs of the sites and staff. One of the devices that will demonstrated is the Embertec Tier 2 Advanced Power Strip which will control an occupant's computer workstation. The other device is the Ibis Intellisocket which controls large plug load end uses such as water coolers, TV displays, and large printers. Key features of the proposed project include outreach and individual education programs to California Community College Districts, evaluation of sites for participation in the project, purchase and installation of APMDs at approved sites, measurement and verification (M&V) activities both pre- and post-APMD implementation at the selected demonstration sites.

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

Reductions in electricity consumption and cost could be delivered to the participating Community College Districts via the implementation of the APMD technology. The savings will accrue as the devices are deployed in a phased approach, and be fully achieved once the EPIC project is complete. Following project completion, the APMD systems will continue to provide savings throughout their 8 to 10 year expected useful life. Successful

deployment at participating Districts could be leveraged to expand technology adoption to other community colleges.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: A conservative estimate of savings to the participating California Community College Districts is $850,000 per year in immediate and ongoing annual savings.

Consumer Appeal: The project gathers a wide range of data about the technology and its performance that will be incorporated into an outreach campaign to build awareness and accelerate adoption of APMD technology with IOUs, technology vendors, and property owners in institutional and commercial buildings statewide. In addition, APMDs will provide a new data visualization capability and plug load energy information system to the participating sites.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$181,505

EPIC Funds Encumbered:

$1,264,296

EPIC Funds Spent:

$1,074,444

Match Partner and Funding Split:

Ibis Networks: $357,047 (18.9 %)

Embertec: $33,115 (1.8 %)

Newcomb Anderson McCormick, Inc.: $235,324 (12.5 %)

Match Funding:

$625,486

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 2: 13 out of 15 bidders

Rank of Selected Applicant / Bidder:

Phase 2: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient is nearing the final installation of the units at all participating community colleges and will start 1-year of post-installation monitoring and evaluation to verify the energy reduction of the plug load controls.

Project Name: EPC-17-015 - Installation and Soft Cost Reduction for Horizontal Single Axis Trackers (Stage II)

Recipient/Contractor: Nevados Engineering

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/21/2017 to 12/31/2019

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S17: Provide Federal Cost Share for Technology Demonstration and Deployment Awards.

Issue:

The solar industry has historically focused on flat land for project installations. However, flat land is not widely available and is often expensive and dedicated to other uses like housing, roads, farming, etc. While flat land is not necessary for solar installations, solar mounting systems have historically been designed for flat land applications. This limits potential installation sites, often requires substantial earth work to prepare a site for solar power plant installation, and can result in substantial environmental degradation during the process.

Project Description:

This project is demonstrating a novel single axis solar PV tracking system suitable for sloped and rolling terrain. This will help solar developers build projects on lands closer to load centers and interconnection points that typically would not be considered, creating more site options. The construction costs are reduced by eliminating the need for grading soil and environmental mitigation costs can be cut as well. The new tracker was developed through a DOE award and a full-scale system is under testing at a rolling terrain near Davis, CA. The Energy Commission grant is funding improvements and testing of the various tracker components in an effort to find cost-cutting opportunities to update the product design and optimize it for full-scale manufacturing.

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

This project focused on creating products to facilitate the move from flat land installation sites to non-flat land sites to accelerate the growth of solar installations leading the state to a 100% clean energy future.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) California Solar Initiative: R.12-11-005

Applicable Metrics: CPUC Metrics- 1e, 2a, 3a, 3b, 4a

Lower Costs: Installing the new solar tracking system on sloped, rough, and rolling terrain, will eliminate the need for soil grading typically necessary for solar installations, resulting in 3-10% total project cost reductions. This also increases application zones for the system to areas where only low-efficiency fixed tilt systems could be installed before, and can increase output by up to 7% over other tracking systems if installed on a south-facing slope.

Economic Development: Through further development, testing and certifying of equipment, pilot manufacturing and business case analysis that will lead to anticipated manufacturing cost to $0.128/W or less, the technology will be competitive in the industry allowing commercialization and subsequent economic development.

Environmental Benefits: The new tracker removes the need to grade top-soil, helping preserve the environment at the site. As soil grading is diminished, millions of gallons of water usage currently sprayed on dry disturbed soil to mitigate dust at construction sites can be eliminated.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$76,846

EPIC Funds Encumbered:

$999,822

EPIC Funds Spent:

$888,985

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy : $1,999,644

Nevados Engineering, Inc.: $920,126

Steve Ihnen: $62,496

Nick Foster: $17,200

Leveraged Funds:

$2,999,466

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team completed substantial work on the All-Terrain Tracker and the product is now commercially ready. However, further work will continue to bring down the costs, expand the product capability, and expand the products offered. The version of the product that was ready at the end of the project includes a single axis tracker that can fit to flat, sloped, and rolling terrain on slopes of up to 37% grade and with changes in slope along the length of the row of up to 17% grade at each bearing assembly. The team has also developed software products for optimum operation and control and remote monitoring. These products are commercially ready to enable sale, manufacturing, and deployment of the tracker. Nevados has already sold and installed the new tracker system at several customer sites.

Project Name: EPC-17-016 - An Online Siting Tool Application for Woody Biomass-to-Electricity Facilities in California

Recipient/Contractor: University of California, Davis

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 11/8/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

It has been estimated that $650,000 of up-front capital is necessary in the current investment landscape to develop a biomass-to-electricity project to the point at which private capital will invest. Much of those costs are related to evaluating feedstock supply, harvest methods, transportation costs, and grid capability. Many businesses and communities that aspire to produce energy from woody biomass are small businesses, start-ups, or communities that cannot easily afford the preliminary studies necessary to assess project feasibility and how to begin development.

Project Description:

This project develops a decision support system that will reduce the soft costs of estimating and planning new bioenergy power plants that consume woody biomass from sustainable forest management activities. The open-source facility-siting tool will be hosted online and will allow users to quickly evaluate economic feasibility and environmental performance potential of particular locations for developing a wood-based biomass power plant. The project includes case study analysis to understand feasibility and barriers to developing biopower facilities in high-risk hazard zones.

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

This project will increase the cost competitiveness of biopower plant projects, resulting in expanded opportunities for using biomass waste streams. The online and open application architecture will ensure that everyone has open, public access to this resource.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

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

Lower Costs: This bioenergy facility siting tool will achieve lower costs for renewable biomass electricity generation by reducing the cost of siting a bioenergy facility, thus increasing the cost competitiveness of bioenergy facility projects. Approximately $650,000 in up-front capital is necessary to develop a project to the point at which private capital will invest. Much of those costs are related to evaluating feedstock supply, grid capability, etc., which can be supported by the proposed application. Assuming 40% of the project initial development cost can be reduced by the siting tool, the application could save about $260,000 per project.

Increase Safety: The bioenergy facility siting tool will reduce risk of wildfire impacts to grid infrastructure by facilitating markets for residual woody biomass, thus reducing a potential wildfire fuel source.

Environmental Benefits: This tool will expand opportunities to use biomass waste streams that would otherwise contribute to criteria air pollutants and higher levels of climate pollutants from prescribed burns or wildfire. For a 3 MW facility, local and regional emissions reductions for NOx, PM10, VOC, CO, and CO2eq are estimated to be 80.4, 193.7, 149.6, 1,879, and 9,582 tons per year, respectively (Springsteen et al., 2011).

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$203,977

EPIC Funds Encumbered:

$1,222,284

EPIC Funds Spent:

$74,471

Match Partner and Funding Split:

Regents of University of California, Davis: $28,523 (2.3 %)

Match Funding:

$28,523

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

UCD's request to the U.S. Forest Service (USFS) Pacific Northwest Resource Monitoring and Assessment team to use the latest "LEMMA LT-GNN" spatial forestry inventory data was denied. Instead of this data, UCD has decided to base its project siting support tool on the "F3" model data developed by the USFS's Region 5 Remote Sensing Lab. The F3 data is currently limited to the Sierra Nevada region, but the F3 team plans to expand the data to all of California. UC Davis is now focused on developing a pilot version of its tool for the Sierra Nevada, then expanding the tool for the rest of California once the respective F3 data is released.

Project Name: EPC-17-017 - The Nexus of Clean Energy, Healthy Forests, and a Stable Climate: Innovative Biomass Gasification for Sustainable Forest Management

Recipient/Contractor: All Power Labs, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 10/27/2017 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S3: Develop Innovative Solutions to Increase the Market Penetration of Distributed Renewable and Advanced Generation.

Issue:

Climate change contributes to California's forest health crisis, with a tree mortality emergency of over one hundred million dead trees, at risk of being ignited in catastrophic wildfires. There is a need for an economical and climate-sensitive way to reduce the risk of catastrophic wildfire, while also addressing the state's need for renewable energy. All Power Lab's pre-commercial Powertainer technology -- a containerized 150kW gasification system that converts forestry waste into renewable energy and sequestered carbon -- is designed to run profitably under the SB1122 BioMAT feed-in-tariff. Yet high technological and economic barriers to widespread commercial deployment remain.

Project Description:

This project supports the development of the Powertainer+ (PT+) -- a multi-modal power and products platform designed to generate low-cost renewable energy, process thousands of tons of forestry waste, and sequester carbon. The Powertainer+ will include a combined heat and power module, increase the power capacity (from 150kW to between 210-250kW), and increase the forestry waste processing capacity to up to 2200 bone dry tons per year.

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

Broadly, the goals of this project are to decrease the modular technology platform's levelized cost of electricity, increase its forestry residue processing capacity, add new value streams in the forms of hot water and biochar production, and enhance the system's carbon sequestration capacity.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) SB 1122 Bioenergy feed-in tariff: R.11-05-005 Combined heat and power: D.10-12-035., R.08-06-024. (closed)

Applicable Metrics: CPUC Metrics- 1a, 1f, 3g, 4a, 4e

Greater Reliability: The PT+ will increase PG&E's grid reliability by reducing peak loading by up to 250kW. The technology supports increased grid reliability in hard to serve places and reduced peak demand charges for rural businesses under net energy metering arrangements. The technology will provide on-demand, non-weather dependent, renewable energy.

Increase Safety: By creating a market demand for forestry biomass residue, this project will increase safety by creating an economic driver to support sustainable forestry management activities, thus reducing the risk of catastrophic wildfire and the associated damage to the Investor Owned Utility infrastructure, such as transmission lines and remote substations. The proposed size is now receiving over 80% of their materials from CalFire-designated High Fire Hazard Zones.

Economic Development: The PT+'s biochar off-take provides the critical linkage between the forest and agricultural industries' value chains. The PT+ creates economic benefit by selling the biochar it generates to distribution companies or directly to farmers, creating a biochar market out of the nascent demand in California. The biochar sold into this market creates economic and environmental value for the agricultural industry, as it increases soil fertility and water retention and decreases nutrient inputs and runoff.

Environmental Benefits: By processing forestry residue from CalFire designated High Hazard Zones, the PT+ creates demand for biomass that was previously considered waste, creating value and increasing incentives to remove residues that would otherwise not be economical and providing an alternative to controlled open slash burning. This reduces greenhouse gas emissions and lowers wildfire risk.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$1,500,000

EPIC Funds Spent:

$849,563

Match Partner and Funding Split:

Humboldt State University Foundation, Schatz Energy Research Center: $17,235 (0.8 %)

Anderson Biomass Complex: $50,000 (2.2 %)

All Power Labs, Inc.: $682,765 (30.3 %)

Match Funding:

$750,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The team identified critical areas that require validation testing to ensure safe and efficient operation of the PT+ and CCHP modules. The team designed the pre-combustion biochar off-take and conducted a bench-scale test. The biochar test data showed that the system met the char yield target of less than 20%. A combined heat power system is being designed to increase the system efficiency. With all systems running nominally using walnut shells at 50kWe, practically zero tar was measured under high and low char yield rates.

Project Name: EPC-17-018 - Demonstrating the Potential for On-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units

Recipient/Contractor: University of California, Davis

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 11/6/2017 to 10/17/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

The common model for managing food waste generally involves disposal in a landfill where the organic material releases methane gas (a greenhouse gas with 25 times the global warming potential of carbon dioxide) to the atmosphere as it degrades. The conversion of food waste to electricity and heat via anaerobic digestion (AD) provides a promising alternative solution to the current model, but large-scale centralized facilities require expensive and carbon-emitting transportation of food waste over long distances from its source, and small scale decentralized AD systems have not been well-demonstrated in California.

Project Description:

This project assesses the potential for a highly standardized and rapidly deployable decentralized AD solution as a compelling alternative to large-scale centralized AD facilities. By implementing on-site AD at locations where food waste is generated and electricity demand exists, it is possible to reduce or avoid 1) the consumption of non-renewable electricity, 2) the transmission and distribution (T&D) losses associated with the delivery of electricity across long distances on the regional grid, and 3) the transport costs (inclusive of the monetary, environmental, and public health costs) of hauling food waste long distances to feed larger AD generators.

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

This project addresses the knowledge gap regarding the optimal scale for the deployment and use of AD technology to convert food waste into renewable electricity, heat, and fertilizer. To meet this need, researchers will perform techno-economic and environmental assessments of increased deployment of micro-scale AD systems across the state. Researchers will also develop new information about the performance variability of micro-scale AD systems relative to fluctuating and heterogeneous food waste feedstock inputs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1b, 2a, 3b, 3g, 4a, 4e

Lower Costs: The small-scale, on-site AD system will directly avoid the long term costs of electricity supply expansion. The pilot unit is expected to reduce the cold storage facility's net peak demand on the SCE grid by 53 kW, approximately saving $64,752 a year, or $152/MWh. By disposing the food waste onsite and locally (within 7 miles) instead of transporting it to landfills, food waste producers can avoid a total tipping fee of $72,236. At an estimate of 1% market penetration, the decentralized AD technology would save ratepayers $4.78M/year.

Greater Reliability: Onsite sustainable and flexible energy generation will be able to reduce the facility's peak load and potentially minimize the impact of unexpected power outages.

Environmental Benefits: This technology demonstration project will reduce the amount of food waste going to landfills by about 1,220 tons of municipal food waste per year locally. The technology will avoid an estimated 427.2 metric tons of CO2 emissions per year. By implementing on-site AD at locations where food waste is generated and electricity demand exists, it is possible to reduce/avoid 1) the consumption of non-renewable electricity, 2) the transmission and distribution (T&D) losses associated with the delivery of electricity across long distances on the regional grid, 3) the environmental and public health costs of hauling food waste long distances to feed larger AD generators.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$171,649

EPIC Funds Encumbered:

$2,411,007

EPIC Funds Spent:

$29,549

Match Partner and Funding Split:

SeaHold, LLC: $20,800 (0.7 %)

Biodico, Inc.: $610,886 (19.3 %)

UC Davis: $124,447 (3.9 %)

Match Funding:

$756,133

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

UC Davis (UCD) has successfully received permit approval for the Oxnard site. The entire equipment system - anaerobic digester, biogas treatment, microturbine, and CHP system - has been successfully integrated at Impact Bioenergy's equipment manufacturing site. The equipment will be delivered to the Oxnard site for installation and commissioning. UCD completed its site design, Measurement and Verification Plan, Execution Plan, and Operations Manual. UCD has been conducting initial food waste assessments to understand baseline methane generation potential and has presented information on the project to interested stakeholders at several conferences, including FOODIE and ISSST.

Project Name: EPC-17-019 - Burney-Hat Creek Bioenergy

Recipient/Contractor: Fall River Resource Conservation District

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 10/18/2017 to 9/30/2020

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

As of the end of 2016, six of the 10 closest biomass power plants serving northeastern California are closed. The loss of 50 megawatts (MW) of biomass power plants has removed a use for available biomass on surrounding forest lands. With this decreasing number of biomass power plants, there is a growing need to advance cost-effective, efficient and low emissions biopower facilities that are suited to local communities and further emphasizes the need to advance modular biopower technologies that could be economically scaled up and transported or replicated at different forest locations.

Project Description:

This project seeks to bring West Biofuels gasification technology, a technology funded by EPIC under an applied research and development program grant (EPC-14-024), to full commercialization. The West Biofuels gasification solution is designed to utilize forest derived biomass and is ready for scale-up demonstration and deployment. To advance its commercial readiness, this project is developing and demonstrating a community-scale forest biomass facility in the Burney-Hat Creek region that is designed to address the need for increased markets for forest biomass resources. The bioenergy facility will be consistent with the requirements of the BioMAT Category 3 and obtain a power purchase agreement at a financially viable price. The plant will consume about 22,000 bone dry tons (BDT) of forest sourced feedstock per year, generate 2.88 MW of renewable energy at full rated capacity, and have a capacity factor that is greater than or equal to 75 percent.

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

The Burney-Hat Creek Bioenergy facility will be the first commercial deployment of an innovative gasification system that integrates a horizontally positioned rotary gasifier based off a torrefaction reactor, a thermal oxidizer and an Organic Rankine Cycle (ORC) technology in place of internal combustion engine. The technology is expected to overcome important challenges with the use of forest-sourced wood, including environmental compliance and operating challenges that are hindering large scale

bioenergy projects. Under a previous R&D project, West Biofuels took a measured and strategic approach to designing modular gasification system for forest materials, which brings the selected gasification technology from research to commercial operation.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005

Applicable Metrics: CPUC Metrics- 1a, 1b, 2a, 3g, 3h, 4a, 4b, 4e

Lower Costs: California IOU's have been mandated to procure 250MW of biomass electricity through SB 1122. Burney-Hat Creek Bioenergy is a cost-effective option for the utilities to acquire this capacity through SB 1122 BioMAT program. Relatively low capital cost using essentially free feedstock while leveraging a local partnership of technology manufacturer and the construction company, yield a LCOE for the project that is well below the average price identified by Black & Veatch for Category 3 projects for BioMAT categorized as Sustainable Forest Management Byproducts.

Greater Reliability: Distributed forest biomass projects provide important grid reliability in northeastern California, a remote region of the PG&E grid. Burney-Hat Creek Bioenergy will help provide greater reliability through: reduced power losses and the reduction in system harmonics through local distributed generation minimizing the heat generation from long-distance transmission; improved grid resilience to climate change by supporting sustainable forest management and reducing black carbon emissions from wildfire; and faster outage restoration time by providing the opportunity for micro-grid operations limiting the impact of a fault-event.

Increase Safety: By developing the region's biomass infrastructure, the project will promote fire-safe forest management which will reduce local wildfire which protects ratepayer property and grid infrastructure.

Public Health: Diverting biomass from pile and burn reduces criteria pollutants, which cause significant acute and chronic respiratory illness, by more than 75 percent.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$87,037

Match Partner and Funding Split:

Hat Creek Bioenergy, LLC: $5,000,000 (50.0 %)

Match Funding:

$5,000,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team continued to advance a variety of project elements. All interconnection study information has been supplied to PG&E. There has been progress on the interconnection and project finance, although the interconnection agreement is still pending. The preliminary engineering package for the project and the construction cost estimate has been completed by West Biofuels on behalf of Hat Creek Bioenergy. The interconnection agreement expected to be finalized by end of January 2020.

Project Name: EPC-17-020 - Demonstration of Vehicle-Grid Integration under Non-residential Scenarios

Recipient/Contractor: Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 10/10/2017 to 12/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S16: Expand Smart Charging and Vehicle-to-Grid Power Transfer for Electric Vehicles.

Issue:

There are knowledge gaps that inhibit the expansion of electric vehicles (EV) fleet charging including: 1) how to quantify the flexibility of EVs as a resource (in a consistent well-developed and tested methodology); 2) how to develop accurate physical models of charging stations and integrate them with distribution system models; 3) how to quantify and minimize the impact of EV charging on the distribution system assets; and 4) how to calculate the value streams for electric vehicle fleets.

Project Description:

This agreement will demonstrate vehicle-grid integration in non-residential facilities to show the flexibility of smart charging. The team will build and validate models that incorporate usage patterns, quantify the impacts of EV charging, develop controls to manage the smart charging to minimize grid impacts and utility costs, and calculate the value streams and costs associated with realizing those value streams.

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

The project will develop and demonstrate advanced model-predictive control strategies that are more sophisticated than the current state of the art technology by incorporating usage patterns, quantifying the impacts of EV charging while managing the smart charging, and calculating the value streams/costs. This project will demonstrate how to minimize electric vehicle charging effects on the distribution system while analyzing EV fleet capabilities under non-residential scenarios.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 1h, 3f, 4b

Lower Costs: The project will lower grid asset costs by extending the life of distribution grid assets and reducing peak load impacts from uncontrolled charging. In particular, the system could minimize transformer aging in hot climate regions due to reduced loading.

Greater Reliability: This project will provide higher reliability due to mitigation of voltage, current, and harmonics issues with EV clusters. This project is estimated to improve power losses and voltage drop by at least 10% via smart charging.

Environmental Benefits: This demonstration project will accelerate EV adoption, thus reducing greenhouse gases with the adoption of more EVs.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$728,697

EPIC Funds Encumbered:

$2,340,000

EPIC Funds Spent:

$1,577,643

Match Partner and Funding Split:

Google.Inc: $200,000 (6.8 %)

ChargePoint, Inc.: $61,248 (2.0 %)

Kisensum: $75,000 (2.6 %)

UC Santa Barbara: $61,345 (2.1 %)

Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory): $200,000 (6.8 %)

Match Funding:

$597,593

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

29 out of 31 bidders

Rank of Selected Applicant/ Bidder:

Group 4: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The SLAC team developed and demonstrated a model to show how the distribution transformers are aging due to unmanaged EV charging sessions at three different demonstration sites: SLAC, Stanford, and Google. With the real-time data obtained from each site, the team was able to develop smart charging software to optimize EV charging events. The software helped the Stanford Campus operate and optimize its large fleet of EV buses by improving bus schedules and routes. The project team implemented the software at the Google campus to quantify the potential benefits of controlled charging sessions at its large parking facility.

Project Name: EPC-17-021 - Mariposa Biomass Project

Recipient/Contractor: Mariposa County Resource Conservation District (MCRCD)

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 3/21/2018 to 12/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

About 65% of the homes in Mariposa County are at the 2000 - 6000 ft. elevation range in the conifer or mixed conifer zone and are at risk of wildfires and falling trees. There is a need for managing excess vegetation and a need to demonstrate advanced technologies that can economically convert woody biomass while meeting emission standards. However, no commercially proven technology has the flexibility in both the feedstock and fuel outputs. Larger scale biomass plants have difficulty scaling to below a 3 MW size, while small-scale pyrolysis-based systems that use a reciprocating engine have high maintenance costs and low reliability and availability.

Project Description:

This project is designing and constructing a thermochemical biomass-to-energy conversion facility for forest wood waste that will have a capacity between 2.0 and 2.4 megawatt (MW) annually and produce between 15,000 to 18,500 MWh annually of renewable, community-scale, grid-connected electricity. The project demonstrates and optimizes this forest waste bioenergy technology and assesses the performance characteristics and best practices when using wood waste from forest management as feedstock. The project is located in Mariposa, CA -- often referred to as ground zero for the tree mortality disaster -- and will use forest biomass obtained from a high fire hazard zone.

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

The Mariposa Biomass Project has partnered with Cortus Energy to demonstrate an innovate gasification system trademarked as WoodRoll technology. The technology uses a 3-stage drying, pyrolysis and gasification process to produce a clean high BTU syngas, thus reducing costly engine maintenance costs and outages; and the gasification facility will integrate automation and remote monitoring to further reduce operating costs. The WoodRoll facility will have 16 standardized factory-tested modules that can be installed quickly and moved if necessary. The combination of high efficiency and availability combined with low operating and maintenance costs will allow the Mariposa Biomass

Project to be a financially successful small-scale forest biomass demonstration facility that can be replicated in other rural areas with access to sustainable forest biomass supplies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

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

Applicable Metrics: CPUC Metrics- 1a, 1b, 3g

Environmental Benefits: The proposed facility will provide community and state benefits, including forest ecosystem protection (due to removal of dead trees and excess forest growth that can lead to catastrophic wildfires), watershed protection, and air quality benefits and greenhouse gas benefits (by diverting biomass from burn piles and controlled burns and utilizing the biomass as an energy resource in a controlled environment).

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$8,842

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$37,140

Match Partner and Funding Split:

Cortus Energy: $11,135,367 (69.0 %)

Match Funding:

$11,135,367

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team successfully entered PG&E's BioMAT queue in October 2019. PG&E is reviewing this application and the project team is awaiting the execution of the power purchase agreement. Development of a sister plant by the project's major subcontractor, Cortus Energy, has been completed and fully commissioned. Once the power purchase agreement with PG&E is executed, the components will be shipped to the designated plant site in Mariposa County.

Project Name: EPC-17-022 - Skid Mounted Mobile Pilot/Education Unit for Source Separated Organics Processing with Cogeneration Capabilities

Recipient/Contractor: Lystek International Limited

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 11/28/2017 to 11/29/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S13: Demonstrate and Evaluate Biomass-to-Energy Conversion Systems, Enabling Tools, and Deployment Strategies.

Issue:

California is striving to achieve a greater diversion of wastes and increase renewable energy generation. A primary objective of this diversion is to reduce greenhouse gas emissions from controllable sources. As an alternative to traditional solid waste facilities, other existing processing facilities, such as wastewater treatment plants, are being looked at as potential receiving stations for processed organics. The primary output of taking processed organics is greater generation or co-generation of renewable energy. A lack of proven and viable alternatives will delay meeting waste diversion goals and limit possible contributions to renewable energy goals from waste treatment facilities.

Project Description:

The purpose of this project is to construct and demonstrate an innovative technology to pretreat organic wastes prior to anaerobic digestion at a wastewater treatment facility to enhance operational efficiencies and increase biogas production. The pretreatment technology will be constructed as skid-mounted mobile units for processing source-separated organic wastes and biosolids and will have cogeneration capabilities, thereby further increasing the energy generation from the wastewater treatment system

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

This project will combine the organic processes and anaerobic digestion that will yield greater biogas generation and utilization resulting in higher diversion of organic wastes while producing more renewable electricity than conventional digester systems. If successful, the combined technologies will provide wastewater treatment operators with greater confidence in working with organic generators and processors for accepting feedstock material suitable for co-digestion.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and

Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Greenhouse Gas Emission Allowance Cost and Revenue Issues: R.11-03-012

Applicable Metrics: CPUC Metrics- 1a, 2a, 4a, 4e, 5b

Lower Costs: The project will result in lower costs by demonstrating a technology that both diverts organic waste and increases the biogas yield and renewable electricity generation. The increase in gas production can be about 385 kW per ton of organics processed. This is an increase of at least 20% in biogas production for moderate performing anaerobic digesters. The lower quantity of biosolids resulting from the process will lower expenses for disposal management.

Environmental Benefits: The proposed approach to biosolids processing, land application and enhanced energy recovery through the improved anaerobic digestion process may result in net greenhouse gas reductions of 47–65 tonnes of CO2 per 100 dry tonnes of biosolids processed. Assuming 723,000 dry tonnes of biosolids could be converted by Lystek in California for beneficial use every year for biogas enhancement and electricity generation, there is potential for reducing more than 339,800 Mg CO2e of GHGs.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$19,396

EPIC Funds Encumbered:

$1,589,163

EPIC Funds Spent:

$908,502

Match Partner and Funding Split:

GHD, Inc.: $123,000 (5.9 %)

Design2Operate: $58,000 (2.8 %)

Lystek International Limited: $312,075 (15.0 %)

Match Funding:

$493,075

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

The Lystek Thermal Hydrolysis Process will be used as part of the organics-to energy grant project. This patented technology will be used to support the conclusion that energy can be obtained by the digestion of organic matter and the collection/conversion of biogas to electricity.

Update:

The project is running in good standing. The project's air permit was received in August. Commissioning of the equipment occurred in July and August of 2019 and started operations on August 26, 2019 with commissioning of the demonstration digesters. The first delivery of food waste from UC- Santa Barbara was on August 27, 2019. They have been slowly feeding the test digesters since start-up and reached optimum capacity in December 2019. They are now recording measureable volumes of biogas as expected. Plan is to operate at this steady level for the duration of the project and prepare for the energy conversion unit portion. The next step for the project is the energy conversion of biogas to electricity. This should occur sometimes in March 2020.

Project Name: EPC-17-023 - High Performance, Ultra-Tall, Low Cost Concrete Wind Turbine Towers Additively Manufactured On-Site

Recipient/Contractor: Jason Cotrell, dba RCAM Technologies

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 12/26/2017 to 6/30/2021

Program Area and Strategic Objective:

Applied Research and Development

S4: Improve Power Plant Performance, Reduce Cost, and Accelerate Market Acceptance of Existing and Emerging Utility-Scale Renewable Energy Generation Systems.

Issue:

Large wind turbines can tap into higher altitude, higher speed winds that can increase power production. However, their deployment is constrained in part by the challenging transportation and installation logistics and costs associated with large components. As a result, the average conventional wind turbine tower height installed in the U.S. is slightly over 80 meters tall even though an ultra-tall 140 meter tower increases the amount of energy produced by more than 21% at a site with moderate wind shear.

Project Description:

This project aims to develop and test a reinforced concrete additive manufacturing (RCAM) technology for building low cost ultra-tall wind turbine towers onsite at a wind plant. Taller wind turbine towers capture more wind energy from faster winds aloft, but are constrained by transportation size and weight. The key goal is to develop a RCAM technology that can be used to fabricate a wind turbine tower on-site in one day at half of the cost of conventional steel towers, and reduce the levelized cost of wind generated electricity in a low wind speed site by 11%.

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

Substantial recent investments and advancements in concrete additive manufacturing technologies for buildings make this an opportune time to use the RCAM technology for constructing tall wind turbine towers in California. Concrete additive manufacturing technologies are being developed by countries around the world; however, most development has been performed on concrete printing manufacturing methods for buildings that have little or no structural reinforcement necessary. The project team will build upon the state-of-the art technology to develop the innovative RCAM method that incorporates reinforcement in concrete printing for ultra-tall turbine towers.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard: R.11-05-005 (closed), R.15-02-020 (closed)

Applicable Metrics: CPUC Metrics- 2a

Lower Costs: RCAM technology provides new transformative design possibilities that reduce cost and energy consumed by using less concrete and labor than conventional wind tower construction, and by eliminating concrete forms. The RCAM offers the potential of reducing the construction time by 66% and additional cost reduction potential through automation. This technology has the potential to reduce the levelized cost of wind generated electricity in a low wind speed site by 11%.

Greater Reliability: An ultra-tall wind turbine with a hub height between 140-170 meters increases the amount of energy produced as compared, for example, to a typical 80-meter tower. The 140-meter towers have the potential to increase the California land area with gross capacity factors above 35% by tenfold, adding flexibility and reliability of the electrical system by increasing geographic diversity. Ultra-tall towers can also be used with larger rotors to obtain further increase capacity factors.

Economic Development: If the RCAM technology is successfully commercialized, a large number of jobs in wind turbine construction, operations, and maintenance will be created in the deployment of ultra-tall towers. These deployments will also provide lease and tax revenues for California communities. Empirical results for counties hosting wind power projects that were installed between 2000 and 2008 show an increase in county-level personal income of $11,000/MW of installed capacity and an increase in average county-level employment by approximately 0.5 jobs/MW.

Environmental Benefits: Wind deployments avoid substantial emissions of greenhouse gases compared to fossil fuel generated electricity. Wind generated electricity emits up to 120 times less carbon dioxide (CO2e) than natural gas generated electricity and nearly 200 times less than coal on a lifecycle basis (5 g/kwh, 607 g/kWh, and 975 g/kWh respectively). An RCAM 140-m tower is projected to result in 85 times less CO2 compared to natural gas and 138 times less than coal fired generation on a lifecycle basis.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$164,368

EPIC Funds Encumbered:

$1,249,982

EPIC Funds Spent:

$323,646

Match Partner and Funding Split:

Jason Cotrell, dba RCAM Technologies: $62,558 (4.8 %)

Match Funding:

$62,558

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

19 out of 19 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team built a three-dimensional finite element model for a baseline 158-meter wind turbine tower and 158-meter 3D concrete printed wind turbine tower. The considered loading conditions include wind load, seismic load, and dead load of the structure. The model will be used to predict structural behavior such as maximum displacement, load carrying capacity, and maximum stress. The team is also developing and testing prototypes of concrete tower sections. Preliminary concrete mixes and prototypes were built with a mini robot 3D Potterbot and they were mechanically tested in the laboratory. In subsequent phases, the project team will be building and testing larger prototypes.

Project Name: EPC-17-024 - Electric Access System Enhancement (EASE)

Recipient/Contractor: Southern California Edison

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/1/2019 to 12/31/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S17: Provide Federal Cost Share for Technology Demonstration and Deployment Awards.

Issue:

The current trend of rapid solar PV adoption requires a host of grid modernization efforts to manage the substantial progress SCE envisions in decarbonizing the electricity provided on the grid. The existing paradigm for integration of renewables is based around legacy enterprise control solutions and a relatively static distribution planning approach. Dynamic visualization of capacity, automation of the interconnection process, and self-discovery of new devices into distributed control subsystems as part of a hierarchical control paradigm are required to achieve scalable integration of distributed energy resources (DER) in excess of 50% of peak load.

Project Description:

Distributed control capabilities will enable distributed intelligence and control capability to support fast, automated decisions and improve overall resiliency of the system. This project implements a plug and play concept to facilitate service discovery from PV and batteries both under direct control and being controlled via aggregator to streamline all interconnection types and rationalize multiple systems and processes. In addition, the project explores and demonstrates distributing the existing enterprise functions, i.e. state estimation and optimization, out on the distribution system and to the edge, where necessary and desirable to securely operate the system closer to limits. This project is a federal cost share project to SCE's EASE project under U.S. DOE's ENERGISE program.

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

This project will form an architecture and cooperative framework enabling a "system of systems" approach that streamlines the integration of DERs from planning to operations and enables cross optimization between different participants (IOU, third-party DER owners, CAISO) to allow exchange of services and improved use of assets.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Smart grid: R.08-12-009 (closed) Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1d, 1g, 1h, 1i, 3f, 3h, 5b

Lower Costs: The primary mechanism through which this project will benefit investor-owned utility ratepayers is through lower costs associated with streamlining the DER interconnection process and DER integration with utility control systems.

Greater Reliability: This project will streamline the DER interconnection process and the DER integration with utility control systems, and may also facilitate the integration of microgrids.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$75,160

EPIC Funds Encumbered:

$2,000,000

EPIC Funds Spent:

$0

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

United States Department of Energy: $4,188,000

Southern California Edison: $4,000,000

Leveraged Funds:

$8,188,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The agreement was executed in July 2019, and the kickoff meeting was held in August 2019. The subcontractor KITU Systems has completed its customer enrollment plan and developed its system design specifications and integration test plan.

Project Name: EPC-17-025 - TradePro Connect Product and Service Procurement Project

Recipient/Contractor: Cohen Ventures Inc. dba Energy Solutions

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 3/22/2018 to 4/30/2020

Program Area and Strategic Objective:

Market Facilitation

S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.

Issue:

When considering a DER or energy efficiency project, many institutional and residential customers do not have the tools to find the best prices, products, and service providers. Additionally, service providers often face significant complexities for customer purchasing, bidding, and training required to participate in utility programs which would lower project costs.

Project Description:

This project is creating TradePro Connect - an online platform that provides a marketplace that facilitates tailored connections between customers and service providers. It empowers customers to find qualified contractors serving their area; request, evaluate and select bids; and schedule services. Contractors enrolled in the platform will gain access to new work opportunities, an ability to represent their certifications and training, and membership in an exclusive clean energy Group Purchasing Organization. The project aims to enroll a minimum of 100 contractor organizations on the platform, directing at least 30 jobs to small, disabled veteran, minority, LGBT and/or women business enterprises; as well as implement at least 50 projects during the project period. TradePro Connect is being demonstrated by facilitating projects for the SOMAH and SCE Auto DR programs as well as service-territory-agnostic On-Bill Financing (OBF) functionality.

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

By streamlining the customer's buying experience, working with the supply-chain to stock and promote best-in-class products, and ensuring proper design, installation, commissioning, operation and maintenance, the project reduces the cost and risk of DER technology procurement which increases adoption. This leads to lower energy use and GHG emissions and also facilitates compliance with SB 350's Responsible Contractor Policy.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1c, 3b

Lower Costs: TradePro Connect will result in lower DER product costs from suppliers because, apart from a few large firms, contractors and engineers do not receive volume pricing from suppliers. Through TradePro Connect, when service providers participate in the group purchasing organization (GPO), service providers have access to products at costs comparable to volume pricing from suppliers. These savings are then passed down to the customer when a project is performed. Separately, when customers purchase or implement demand side management measures facilitated by this platform, such as smart thermostats and Auto DR services, customers save money by participating in demand response programs.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$159,260

EPIC Funds Encumbered:

$991,110

EPIC Funds Spent:

$704,748

Match Partner and Funding Split:

ASWB Engineering: $10,000 (0.5 %)

Qmerit: $140,000 (7.1 %)

ProQure: $120,000 (6.0 %)

Ecometes: $180,000 (9.1 %)

Cohen Ventures Inc. dba Energy Solutions: $544,084 (27.4 %)

Match Funding:

$994,084

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

15 out of 15 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team soft-launched the TradePro Connect and Manage Your Power landing pages. Currently, there are two utility programs ready to be supported with the platform: Southern California Edison (SCE) Automated Demand Response (Auto-DR) and CPUC's Solar on Multifamily Affordable Housing (SOMAH). Additionally, On-Bill Financing integration is in the process of being added as a non-utility branded program.

As of September 2019, 100 service providers were on the TradePro Connect platform. To encourage projects, TradePro Connect is working with SCE to offer customers free smart thermostats with optional Auto DR integration for additional savings. To get the offer, customers and service providers would have to use TradePro Connect to execute the project, after connecting to each other in TradePro Connect's online bid process.

Project Name: EPC-17-026 - Accelerating the Adoption of EVs as DERs through Fleet Procurement

Recipient/Contractor: Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/16/2018 to 12/31/2021

Program Area and Strategic Objective:

Market Facilitation

S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.

Issue:

Corporate and government fleets across California operate hundreds of thousands of vehicles. Fleet managers face a wide range of uncertainties while considering a switch to an electric vehicle fleet. This stems from an overall lack of awareness and data on issues such as payback time from energy savings, fleet operating costs and whether EV technology, including advancements in range and smart charging, are adequate to meet fleet needs. These uncertainties create formidable barriers for fleet managers making purchasing decisions and inhibit market pull of EVs. This results in most fleet managers choosing to keep conventional vehicles, since they are the familiar choice.

Project Description:

The MyFleetBuy fleet procurement system developed in this project will mitigate uncertainties for fleet managers by providing clarity on cost savings offered by EVs and smart charging, and verifying the range viability of EVs. MyFleetBuy will leverage the sophisticated vehicle physics models underlying the LBNL-developed MyGreenCar technology, analyzing individual fleet vehicle duty cycles and translating the analysis into easy-to-understand graphics. MyFleetBuy will provide fleet managers with a low cost, highly scalable data collection and analytics system with which to compare their options when investing in new vehicles. The platform will accelerate fleet procurement of EVs by raising awareness of options while mitigating the uncertainties that limit their adoption in fleets.

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

MyFleetBuy will raise fleet managers' awareness of EVs while mitigating the risks and uncertainties that inhibit their adoption of EVs. MyFleetBuy will (1) collect high-resolution data on individual fleet vehicles, including driving distances, traffic, terrain, driving style, and more, using low-cost data loggers; (2) analyze these data with sophisticated vehicle physics models; and (3) provide fleet managers with a decision-support tool to compare

fuel costs of conventional, hybrid, or EVs; compare overall operating costs for all vehicles; and, calculate the difference in costs of uncontrolled vs. smart charging for EVs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007

Applicable Metrics: CPUC Metrics- 3a, 4a, 5b

Lower Costs: By encouraging fleet procurement of EVs with smart charging, fleet entities will minimize expensive demand charges and maximize charging during periods where time-of-use rates are lower. The operating costs for fleet entities will also be substantially lower given that typical EV fueling costs are 1/4 to 1/2 of comparable conventional cars. With increasing EV adoption, costs can be lowered for ratepayers overall, as EVs can substantially broaden the base of electric ratepayers that support recovery of the fixed costs of maintaining reliability of utility distribution systems.

Greater Reliability: MyFleetBuy will show fleet managers how smart chargers can save them money, leading to greater penetration of smart chargers instead of uncontrolled chargers. The shift toward EVs with smart charging will help to mitigate excessive demands at fleet charging hubs, thereby avoiding local grid faults, transformer overloading, and excessive voltage deviations.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$115,875

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$713,641

Match Partner and Funding Split:

County of Alameda: $164,398 (5.9 %)

Caltrans: $1,342,440 (48.3 %)

City of Oakland Bureau of Infrastructure and Operations: $272,880 (9.8 %)

Match Funding:

$1,779,718

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

15 out of 15 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the recipient made significant progress on market discovery, customer development, and securing market traction for MyFleetBuy (MFB).

The recipient created a functional prototype of MFB, and has integrated the software with the Alameda County, City of Oakland, and CalTrans pilot fleets' telematics data.

The MFB team has also secured a contract with the National Science Foundation to develop the underlying physics models of MFB and a grant from the City of Fremont to use MFB for municipal fleet electrification. Furthermore, Green Light Labs has taken on MyFleetBuy from LBNL in an effort to commercialize the technology.

In 2020, the recipient plans to: continue development and pilot testing of MFB to fleet partners; continue market discovery with fleet managers; and continue business development to secure contracts and partnerships to scale MFB to government fleet managers.

Project Name: EPC-17-027 - The Distributional Electricity Impacts of Climate Change on California's Residential Communities

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/3/2018 to 4/30/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

California is a leader in addressing climate change and is aggressive in its policies to reduce greenhouse gases as well as local pollutants. While many have studied the national or statewide impacts of climate change, no rigorous analytics have been done to identify how different communities are affected by climate change using empirically calibrated dose response functions at the ZIP code level. Communities will not be affected uniformly; damages will vary by community as a result of climatic conditions, income levels, and population density.

Project Description:

This project studies the impacts of rising temperatures on electricity demand and the related emissions of pollutants from current generation stations. On the demand side, the researchers are creating an empirically calibrated statistical model using household level data to estimate household response of electricity demand to temperature. On the supply side, the study is estimating the implications of the increased intensity and frequency of extreme heat events from climate change on peak demand and local air pollutants, GHG emissions, and costs of generating capacity in the absence of policy intervention or technology change.

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

This project will generate new and precise estimates of the forecasted damages to California's residential communities due to climate change. This will create a scenario in the absence of additional standards and policies (e.g., additional emissions abatement requirements) and hence create a baseline for calculating their value. These two approaches will provide the most comprehensive analysis of the impact of climate change on California's residential communities and particularly on disadvantaged communities.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 2a

Lower Costs: This Agreement will lower costs by forecasting the changes to the electricity system because of climate change so that IOUs, CAISO, and CPUC can plan a more efficient, effective, resilient, and low-cost electricity system with less environmental impact.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$36,240

EPIC Funds Encumbered:

$200,000

EPIC Funds Spent:

$134,790

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 4b: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The researchers have completed running their statistical model for electricity demand in response to climate change. They are now completing the analysis of electricity generation and emissions under climate change.

Project Name: EPC-17-028 - High Resolution Source Importance Mapping to Minimize Impacts of Waste Biomass Distributed Generation on Ozone Air Quality in Disadvantaged Communities in the San Joaquin Valley

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/1/2018 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

To reach California's energy goals, distributed bioenergy generation could play an important role. A recent study showed that bioenergy production at its full potential under currently permitted technologies could exacerbate ozone air pollution in the San Joaquin Valley, where many disadvantaged communities are located. A variety of factors may influence air pollution impacts on disadvantaged communities. Therefore, it is necessary to develop new tools to quantify these impacts and to develop mitigation strategies.

Project Description:

This research includes high-resolution mapping of local and regional sources that influence ozone pollution in disadvantaged communities and non-attainment areas in the San Joaquin Valley across diverse weather conditions. The researchers will use a 3-D chemical transport modeling system in a number of simulations to determine location-dependent emission limits for bioenergy distributed generation deployment needed to protect the public health of disadvantaged communities and meet federal ozone standards. A decision support model will be developed to aid planners in siting distributed bioenergy generation and mitigating associated impacts.

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

This study maps both local and upwind emission sources that contribute to ozone air pollution in disadvantaged communities (DAC) and uses the source importance mapping to develop site-specific ozone mitigation strategies.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4b

Environmental Benefits: The results from this project provide valuable new information for stakeholders regarding the greatest opportunities for efficient and cost-effective minimization of the air quality impacts from biomass distributed generation.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$89,052

EPIC Funds Encumbered:

$200,000

EPIC Funds Spent:

$181,531

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 4a: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The researchers have developed the modeling protocol and are conducting modeling simulations and assessing ozone impact metrics. A report on the modeling simulations was submitted.

Project Name: EPC-17-029 - Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy

Recipient/Contractor: Cal Poly Corporation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/21/2018 to 7/31/2020

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

As California explores opportunities to develop offshore renewable energy capacity, there will be a growing need for pre-construction biological surveys and post-construction monitoring in the challenging marine environment. Underwater video is a powerful tool to facilitate such surveys, but the interpretation of the imagery is costly and time-consuming. Emerging technologies have greatly improved automated analysis of underwater video, but these technologies are not yet accurate or accessible enough for widespread adoption in the scientific community or industries that might benefit from these tools.

Project Description:

This agreement funds a core team of scientists, students, and staff from computer science and marine biology to perform three main development tasks that will lead to open-source artificial intelligence classification capabilities: 1) performing custom convolutional neural network training focused on a number of key benthic species using an iterative training process to improve the accuracy of the prediction model; 2) developing "intelligent" video/image annotation tools to augment the capabilities of existing Video Annotation Reference System from the Monterey Bay Aquarium Research Institute to streamline annotation/classification workflows; and 3) moving the annotation software, workflow, and tools to the cloud to provide widespread adoption and customization capabilities for the broader scientific and consulting community.

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

This project provides advanced tools to scientists to facilitate the efficient collection of higher quality data that will provide regulators, decision makers, and the public with greater scientific certainty regarding the impact of marine renewable energy on California's marine ecological resources. Reducing the regulatory uncertainty of marine renewable energy production will provide decision makers with better information about impacts of offshore renewables as California seeks to achieve its Renewables Portfolio

Standard (60% renewable electricity by 2030) and the 100% renewable and zero-carbon electricity goal established in Senate Bill 100.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 2a, 4f

Lower Costs: This project will lower costs by automating a costly and time-consuming tasks in marine biological surveys associated with the planning and permitting of offshore renewable energy facilities.

Environmental Benefits: This project will provide regulatory agencies, decision makers, and stakeholders with higher-quality, lower-cost data on marine ecosystems and the potential impact of offshore renewable energy technologies (including wind and wave energy technologies) on those ecosystems.

Consumer Appeal: Reducing the scientific uncertainty in the assessment of marine ecosystems and potential impacts is important to gaining stakeholder acceptance of offshore renewable energy deployment.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$29,057

EPIC Funds Encumbered:

$199,978

EPIC Funds Spent:

$138,350

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 4b: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team is nearing completion of the development of the video annotation software and annotating the pilot underwater video from the Monterrey Bay Aquarium Research Institute. They developed the machine learning portion of the project to automate the identification of target species in the video. They are fine-tuning the machine learning algorithm to achieve the desired accuracy level. Computer science students are gaining real-world experience coding the software, while marine biology students are learning to identify species in the underwater video. A no-cost time extension was approved to extend the project to July 2020.

Project Name: EPC-17-030 - California Opportunities for Procurement to Accelerate Clean Energy (Cal-OP ACE)

Recipient/Contractor: Prospect Silicon Valley

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/2/2018 to 3/31/2023

Program Area and Strategic Objective:

Market Facilitation

S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.

Issue:

More distributed energy resource (DER) solutions must be deployed and adopted to meet California's energy policy goals of reducing GHG and doubling energy efficiency. Scaling DER solutions can simultaneously help buyers and sellers, but there are barriers in connecting the two parties. Large institutional customers typically purchase equipment through formal procurement processes not suited to the culture and resources of clean energy ventures. For DER technology companies to sell into institutional and commercial markets, they must navigate complicated institutional procurement processes, and procurement customers must overcome structural inertia to adopt new DER technologies.

Project Description:

This project will establish a new incubator program specifically geared towards bridging the gap between California clean energy companies and institutional/commercial customers that rely on formal procurement processes to purchase DER solutions and packages. The project will provide and coordinate key services, assistance, and resources needed to bridge the gap between emerging energy technology solutions and large-scale procurement processes. Cal-OP ACE will provide support to clean energy ventures navigating and competing in institutional energy procurement processes, while providing guidance to customers updating and streamlining their procurement processes for advanced DER technologies. Cal-OP ACE will be responsible for facilitating information sharing so clean energy ventures are aware of market opportunities provided by institutional customers; and institutional customers are aware of new DER technology features that can address their critical needs.

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

The need for connecting DERs to Integrated Demand Side Management (IDSM) strategies has been well-established in the following state policy contexts: 1) California energy code (Title 24) requirements for building controls and demand response (DR) capabilities; 2) AB 802 requirements for utilities to shift to Normalized Metered Energy

Consumption (NMEC) to inform more rigorous utility pay for performance efficiency programs; 3) SB 350 doubling energy efficiency targets and rolling out a responsible contractor policy to ensure proper installation and commissioning of DERs; and 4) AB 793 energy management technology requirements.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007

Applicable Metrics: CPUC Metrics- 1c, 1f, 2a, 3e

Lower Costs: Cal-OP ACE will reduce costs in many ways, including but not limited to: leveraging purchasing power of institutional buyers, enabling peak demand reductions and energy and water savings from more efficient products, providing demand charge mitigation and DR opportunities from connected buildings and battery storage, and reducing maintenance costs from better equipment warranties and proper commissioning.

Consumer Appeal: By focusing on enhanced product effectiveness, clear performance standards and certifications, strong warranties, interoperability, and robust verifiable savings, the Cal-Op initiative will help increase DER awareness and adoption in the broader consumer marketplace as well as among large institutional buyers.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$128,875

EPIC Funds Encumbered:

$3,998,715

EPIC Funds Spent:

$872,421

Match Partner and Funding Split:

Prospect Silicon Valley: $51,550 (1.0 %)

Energy Solutions: $700,000 (13.4 %)

Lawrence Berkeley National Laboratory: $150,000 (2.9 %)

TerraVerde: $100,000 (1.8 %)

Ecomedes: $141,000 (2.7 %)

California State University - Office of the Chancellor: $101,900 (1.9 %)

Match Funding:

$1,244,450

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

15 out of 15 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Since the project started in August 2018, Prospect Silicon Valley has developed two critical surveys for institutional buyers and DER technology providers to assess buyers' awareness of existing procurement programs, opportunities for improvement, and requirements for institutional procurement. Moving forward, the project work will concentrate on creating and implementing Procurement Initiatives that will address the barriers identified from the surveys. These Procurement Initiatives will be scoped to streamline the adoption of DER technologies through formal procurement processes by improving access to product and service information, developing effective contract language, and establishing goals and procurement roadmaps based on benchmarking.

Project Name: EPC-17-031 - Port of Long Beach Microgrid - Resilience for Critical Facilities

Recipient/Contractor: City of Long Beach, Harbor Department (Port of Long Beach)

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/23/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

The Port of Long Beach is planning a zero-emissions future in which electricity will be the predominant fuel and the Port-wide electrical load is expected to quadruple. This will create a significant strain on the utility grid because the difference between base load and peak load is likely to widen. Increased reliance on electricity adds risk to marine terminal operations in that a single point of failure, such as a grid outage, could result in millions of dollars per day of damage to the economy. Microgrid systems that integrate zero-emission distributed energy resources (DER) and grid services will add resiliency to Port operation.

Project Description:

This project will create a microgrid at the Port's critical response facility, the Joint Command and Control Center (JCCC). Key features include photovoltaic energy production, stationary battery energy storage, mobile battery energy storage, and a microgrid controller. Both batteries will provide grid services, such as demand response and peak shaving, during regular operation of the utility grid. During wide-spread outages or emergencies, the microgrid will support the Joint Command and Control Center, which coordinates response to emergencies. The mobile battery will act to extend the microgrid as a zero-emission generator that can be deployed where needed, such as stormwater pump stations and refrigerated container yards.

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

The project has several innovations, including the ability to allow for direct DC transfer of energy from the PV system to the battery, significantly improving the efficiency of the stored energy, and testing charge and discharge strategies for the mobile battery to support load reduction during normal operations and providing support power to various distributed critical loads in an emergency.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013

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

Lower Costs: The Port microgrid will reduce load during normal operations, which will lower the Port energy costs. Smart load management reduces demand on the utility grid, specifically of peaking power, which provides important but high-cost electricity. This microgrid installation will also integrate new solar PV capacity, reducing the net demand on the Southern California Edison (SCE) system. These two factors will lower costs to electricity ratepayers by reducing expensive peak power needs and increasing the longevity of existing grid infrastructure through the production of onsite power.

Greater Reliability: The Port microgrid will add stationary energy storage and demand response capabilities, allowing the Port JCCC to respond to utility signals and reduce demand during peak periods. Strategic load shaving in response to utility signals improves the reliability of utility grid services, particularly during times of peak demand.

Energy Security: The Port microgrid will provide important ride-through capabilities during a power outage, allowing the Port JCCC to maintain uninterrupted operations as the microgrid switches to islanded mode. Additionally, the solar PV system mitigates against fuel supply risk in an emergency, allowing for long-term all-renewable operations.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$95,909

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$116,951

Match Partner and Funding Split:

National Renewable Energy Laboratory: $240,000 (3.4 %)

Electric Power Research Institute, Inc.: $80,000 (1.1 %)

Advanced Power and Energy Program (APEP) - University of California, Irvine: $80,000 (1.1 %)

City of Long Beach, Harbor Department (Port of Long Beach): $1,120,000 (15.7 %)

Schneider Electric Buildings Americas, Inc.: $550,000 (7.7 %)

South Orange County Community College District: $50,000 (0.7 %)

Match Funding:

$2,120,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

54 out of 60 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Thirty percent of the microgrid design has been reviewed and approved following multiple system design iterations for addressing site constraints. A workforce development study has begun that will identify the workforce needs for supporting a microgrid. The outputs of the study will be used by a community college to develop microgrid training packages. Initial cyber-security development work has explored various system configurations to address operational user needs, real-time system communication requirements, and protective features. Learnings from this preliminary cyber security work have highlighted the complexity of microgrid systems integration and operational communications. The Port of Long Beach Microgrid won an award from *Power Magazine* in July 2019.

Project Name: EPC-17-032 - Miramar Microgrid - Flight Line Resilience through Landfill Gas and Energy Storage

Recipient/Contractor: The Regents of the University of California, on behalf of the San Diego campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/23/2018 to 1/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Miramar Marine Base is a critical military facility that requires energy reliability and resiliency for mission critical operations. The Base's availability of intermittent bio gas generators can meet the electrical demand. However, the generators can be interrupted with the inconsistent flow of landfill bio gas. When this happens, the electrical power is switched to natural gas generators that can take considerable starting time to fully power up the Base and impact the Base's ability to reduce fossil fuel use. The microgrid and storage batteries envisioned by Base operations will help mitigate this issue while also increasing energy reliability and resiliency.

Project Description:

This project will demonstrate a microgrid at Marine Corps Air Station Miramar. It will incorporate distributed energy resources including: bio gas generators, solar PV, battery energy storage, and electric vehicles. When operational, the microgrid will help maintain critical flight line facilities during grid outages and facilitate higher renewable generation from landfill gas (LFG) generators.

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

This project is incorporating a large scale battery storage system, as well as advanced demand response controls, into a very complex microgrid with a heavy penetration of renewables and over 100 buildings worth of load. Energy storage will allow the microgrid to incorporate higher penetrations of renewable landfill power in island mode, while mitigating demand charges in economic mode, saving money for the Base. This project will address critical challenges associated with instantaneous power loss from the bio gas generators by using microgrid controlled distributed energy resources. Furthermore, project findings will be relevant to landfill gas generation facilities, wastewater treatment plants with biogas generation, as well as hospitals, ports, and military bases.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3h, 4b, 5a

Lower Costs: The battery energy storage system will reduce utility peak load and demand charges, which will help the Base reduce overall energy costs. This will also result in less reliance on the utility grid during peak periods and during LFG outages. This will allow the utility to defer infrastructure upgrades including distribution systems and peak generation plants.

Greater Reliability: The microgrid will be able to shift net load to participate in time-based demand response programs and improve regional transmission constraints.

Public Health: The microgrid will reduce the use of the 1.8 MW diesel generator on the Base, which will reduce emissions for the Base population. The reduction in grid congestion will help the local utility reduce reliance on peaker plants, which also reduces local air pollution.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$425,962

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$86,615

Match Partner and Funding Split:

Marine Corps Air Station Miramar: $6,002,320 (54.6 %)

Match Funding:

$6,002,320

Leverage Contributors:

U.S. Department of Defense: $20,000,000

Leveraged Funds:

$20,000,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

54 out of 60 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team analyzed cost estimates for different battery power and energy combinations to help identify Miramar's energy storage requirements (1.9MW/2MWh) and selected Schneider Electric as the battery vendor. The team completed the microgrid design report, which analyzes load and generation data to assess outage frequency and duration and outlines microgrid use cases for reliability and economics. In terms of design, the team developed engineering drawings for the battery energy system and microgrid controller to 60% completion.

Project Name: EPC-17-033 - Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/20/2018 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Electricity sector operations, risk management, and planning require best-available and peer-reviewed data on projected climate and weather-related parameters to maintain safe, efficient, and reliable energy. California's energy infrastructure, including power generation facilities and transmission lines, is vulnerable to climate-related risks and extreme weather events that may differ significantly from historical records due to a changing climate. Understanding projected climate-related risks that may cause disruption and energy vulnerability is critical to energy sector resilience and planning.

Project Description:

This project builds on the Cal-Adapt platform to provide enhanced tools, data services, and visualizations that leverage existing web infrastructure and features to improve usability to energy sector stakeholders. The research team will collaborate closely with the Energy Commission and energy stakeholders, including IOUs and the California Independent System Operator, to build on Cal-Adapt, developing enhanced targeted visualizations and tools that allow for improved decision support that leverages projections of parameters associated with climate-related risk. Priority tools will address sea level rise and wildfire. These new tools are being designed in close coordination with stakeholders, as the requirements of each organization necessitate tools that are specific to their application needs. Targeted visualization tools depict climate-related risks from a variety of stressors on electricity infrastructure, enabling improved planning for future reliability.

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

This project is providing needed actionable information to energy sector stakeholders regarding climate change consequences on electricity generation and distribution. California's energy system is facing, and will continue to contend with, a changing climate. Substantial changes in the climate are projected to occur within a timeframe that overlaps with the time horizons of a variety of electricity system planning decisions, such

as siting of power generation facilities and transmission lines. Regionally downscaled climate projections with high spatial resolution are valuable resources to better plan electricity and energy infrastructure developments, adaptations, and future siting.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 3a, 5c

Greater Reliability: This project will improve electricity reliability by supporting electricity sector planning, management, and adaptation. These benefits are derived from enhanced Cal-Adapt visualization tools that allow integration of up-to-date, peer-reviewed scientific research pertaining to climate-related risk.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$172,916

EPIC Funds Encumbered:

$900,000

EPIC Funds Spent:

$385,786

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project has developed and released a Data Download Tool, making it possible for users to discover and access climate data for California from the state's scientific and research community hosted on Cal-Adapt. The researchers have also developed a public RESTful API for programmatically accessing climate data hosted on Cal-Adapt, making it easier to build data-driven applications and analyses. The API allows users to access only the data they actually need, without having to download the entire dataset. These tools were developed with input from Technical Advisory Committee members, from meetings with electricity IOUs, and from users via webinars. The research also took steps to develop an enhanced Wildfire Tool and an Enhanced Sea Level Rise Tool.

Project Name: EPC-17-034 - California Energy Product Evaluation Hub

Recipient/Contractor: The Regents of the University of California, Davis-Western Cooling Efficiency Center

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/23/2018 to 3/31/2023

Program Area and Strategic Objective:

Market Facilitation

S19: Facilitate Inclusion of Emerging Clean Energy Technologies into Large-Scale Procurement Processes.

Issue:

Large customers responsible for procurement contracting are often times overwhelmed by the many choices and uncertainties surrounding advanced distributed energy resource (DER) technologies. New technologies entering the marketplace often lack rigorous, real-world evaluations that prioritize customer needs, leaving customers without pertinent details required to make better, more informed purchase decisions. This can add significant time and costs to the procurement process and deter customers from pursuing advanced DER solutions.

Project Description:

This project will develop the California Energy Product Evaluation (Cal-EPE) Hub to conduct and disseminate evaluations of advanced DER products relevant to large commercial and institutional customers through a web-based buyer's guide. To accomplish this, the recipient will: (1) determine Cal-EPE Hub user (i.e. large commercial and institutional customers) needs; (2) develop a list of product categories to evaluate based on user needs; (3) develop evaluation guidelines and methodologies; (4) acquire (through purchase or donation) and evaluate products from product categories; and (5) develop a web-based Buyer's Guide, which will contain the results of product evaluations and related information and documentation.

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

The California Energy Product Evaluation (Cal-EPE) Hub will increase the adoption of advanced DER technology products in the marketplace by disseminating reliable and independent product evaluations to large commercial and institutional customers, through a web-based buyer's guide, which will help these customers more confidently select the DER technology they require with their procurement process.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Long-Term Procurement Proceeding (LTPP): R.13-12-010 (closed) Water-Energy Nexus: R.13-12-011 (closed)

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

Lower Costs: The California Energy Product Evaluation (Cal-EPE) Hub will reduce vendor noise that can add significant time and cost to procurement of DER solutions.

Consumer Appeal: The California Energy Product Evaluation (Cal-EPE) Hub will increase consumer confidence that the DER technology solutions they are procuring are "best-in-class".

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$3,915,128

EPIC Funds Encumbered:

$10,993,646

EPIC Funds Spent:

$180,977

Match Partner and Funding Split:

Lawrence Berkeley National Laboratory: $675,000 (5.1 %)

Cohen Ventures Inc. dba Energy Solutions: $420,000 (3.1 %)

Center for the Built Environment - UC Berkeley: $120,000 (0.9 %)

Local Government Commission: $25,000 (0.2 %)

Collaborative for High Performance Schools: $25,000 (0.2 %)

Sheet Metal Workers 104 & Bay Area Industry Training Fund: $99,000 (0.7 %)

Western Cooling Efficiency Center - UC Davis: $983,629 (7.4 %)

Match Funding:

$2,347,629

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

15 out of 15 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has completed the following in 2019:

- Completed interviews and surveys with target customers and used these findings to complete and prioritize the list of product categories for Phase 1 and 2 testing.
- Compiled a list of Product Advisory Group (PAG) members, per product category.
- Held PAG meetings and used feedback to finalize product evaluation guidelines and the list of specific products (i.e. models) that will be tested in Phase 1.
- Completed the Hub Website Development and Outreach Guide, and Buyers Guide Outline, describing the planned content that will be included on the hub website.

In early 2020, the recipient will focus on the following:

- Completing final test protocols and procedures for Phase 1 product category testing.
- Preparing and starting Phase 1 evaluations.
- Preparing PAG member lists for Phase 2 evaluations.

Project Name: EPC-17-035 - Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/1/2018 to 1/31/2022

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Fresno includes many disadvantaged communities with high unemployment and poor air quality, and its high pollution load contributes to adverse health outcomes. The disadvantaged communities in Fresno also suffer from lack of air-conditioning or cannot afford to run air conditioning during hot summer months, which significantly impacts occupant health. At the same time, access to clean technology options (e.g. solar PV, major energy efficiency upgrades, battery-electric vehicles) is constrained in disadvantaged communities by many structural barriers.

Project Description:

This project develops a holistic community action plan to achieve climate benefits and air quality improvements through energy efficiency measures, electrification, and distributed energy resources in the residential building and light-duty and medium-duty transportation sectors in the City of Fresno. Field surveys and validation testing provide inputs on appropriate implementation strategies and selection of systems and technologies to overcome barriers associated with site characteristics and user responses. Researchers monitor energy use and air quality in typical households within disadvantaged communities to inform analysis of energy programs.

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

This project provides state-of-the-art information and analyses on the impacts of prioritized and integrated energy efficiency, electrification, distributed energy resources, and battery electric vehicles in the Fresno area in relation to climate benefits and air quality improvements.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 2a, 4b

Public Health: The energy action plan developed by this agreement will provide the City of Fresno and other similar cities in California pathways to reduce energy costs to their residents and to improve air quality and public health.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$401,103

EPIC Funds Encumbered:

$1,100,000

EPIC Funds Spent:

$454,691

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

Strategic Growth Council: $1,000,000

Leveraged Funds:

$1,000,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 2b: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The first community workshop was held in August 2019 at Columbia Elementary School in Fresno, CA. The workshop facilitated input on energy survey topics and questions. Energy surveys were conducted in designated project communities. The research team has also compiled building data from publicly available sources, and the neighborhood-scale City-BES modeling tool (CityBES.lbl.gov) has been updated to include building data for south Fresno neighborhoods of interest. Data includes building vintages and floor sizes for all residential buildings.

Project Name: EPC-17-038 - Camp Parks Army Microgrid - A Blueprint for Nested, Modular Design

Recipient/Contractor: DOE- Lawrence Berkeley National Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 12/7/2018 to 3/30/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Military bases must ensure uninterrupted energy access, optimal use of energy resources, and building energy security and resilience to reduce vulnerability and risks. To maximize the use of bases, the military is moving toward multiple zoning with mixed military and commercial tenancy, collaborating with local communities to implement innovative, sustainable technology and business solutions. Enabling smaller microgrids nested within a larger microgrid would give the military the greatest flexibility and resilience.

Project Description:

The Parks Reserve Forces Training Area (PRFTA) microgrid project will produce a permanent, modular, nested design that maximizes renewables and is inherently secure, expandable, economically viable and efficient. The project will deliver a blueprint for incorporating multiple distributed energy resources (DER); a vendor-neutral microgrid control system; and a resilient nodal building block approach that supports grid-within-grid nesting. The project will also develop engineering guidelines and an easy-to-adapt "how-to" case tool for accelerated adoption and commercialization.

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

This project will demonstrate how a nested set of smaller microgrids within an overall base microgrid can be designed and operated to provide resilience on the base, while substantially reducing energy use and the need for multiple backup diesel generators. This approach can be transferrable to other military bases or similar commercial or academic campuses or local communities to improve resilience.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1h, 2a, 3h, 5a

Lower Costs: The base will be able to reduce electricity procurement by ~3,100 megawatt-hours (MWh) per year. The expected savings at PRFTA is ~$600,000 per year.

Additionally, ratepayer benefits from the installation of a 2 MW PV with 2 MW/4 MWh energy storage would enable the utility to defer up to 1 MW of distribution level upgrades at the local substation.

Environmental Benefits: The project will reduce GHG emissions by ~1,300 tons and the use of diesel generators as backup power.

Energy Security: It would ensure energy quality and reliability, and continuity of critical operations in islanded mode with renewable assets for the requisite 14 days.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$817,221

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$1,649,032

Match Partner and Funding Split:

Customized Energy Solutions: $30,000 (0.2 %)

Ultrasolar Technology: $287,900 (1.8 %)

U.S. Army: $11,093,000 (67.6 %)

Match Funding:

$11,410,900

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

54 out of 60 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team completed the microgrid design for the army base, and held the first technical advisory committee and critical project review meetings. All subcontracts have been signed and are in place. The $11 million cost-share from the Department of Defense for this project has been secured.

Project Name: EPC-17-039 - DER-VET A Distributed Energy Resource Value Estimation Tool

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

Grid planners and technology developers struggle with designing and siting microgrids to achieve the most significant economic opportunities. Currently, there is not a good way to determine the right size of individual distributed energy resources (DER) and the benefits and challenges of their integration to meet a facility's needs. These factors and the microgrid location will affect the economics of the microgrid, impacting financial payback.

Project Description:

This project will develop the Distributed Energy Resource Value Estimation Tool (DER-VET), a publicly-available, open-source, microgrid valuation, and optimization software tool to aid in the design of microgrid and distributed energy resource deployments.

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

This agreement will lead to technological advancement and breakthroughs by developing a new tool for microgrid development for utilities and developers that will evaluate how the DER and microgrid systems can be optimized for sizing, owner benefits, and tool as a flexible grid resources.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013

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

Lower Costs: The tool will allow microgrids to be developed with an optimal mix of DER to maximize financial return through cost savings and by providing grid services such as demand response or ancillary service participation.

Greater Reliability: The tool will evaluate how microgrids will provide reliability and resiliency to the grid through better integration of renewable sources and reduced or avoided outage times.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$479,496

EPIC Funds Encumbered:

$2,000,000

EPIC Funds Spent:

$238,258

Match Partner and Funding Split:

XENDEE: $170,800 (6.7 %)

Electric Power Research Institute, Inc.: $397,310 (15.5 %)

Match Funding:

$568,110

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the EPRI team tested and released the alpha version of DER-VET. EPRI is also improving the tool based on the feedback received from internal and external users. EPRI is finalizing the prototype and the wireframe of the graphic user interface to enhance the efficiency and ease of use for the end-users. EPRI will release the beta version in early 2020.

Project Name: EPC-17-040 - Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities

Recipient/Contractor: Rocky Mountain Institute

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/29/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development, Technology Demonstration and Deployment

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors., S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

The Net Zero Energy Coalition, an organization focused on accelerating market adoption of net-zero energy buildings and communities in North America, states in its 2017 Residential Zero Energy Inventory that only 5,279 new single and multifamily units in California are currently operating at ZNE performance or zero energy ready. This represents a very small portion of the existing building stock of nearly 13 million units per the 2017 US Census. To achieve the state's zero carbon goals especially for multifamily buildings by 2030, research is needed to identify opportunities to drive down retrofit costs, energy costs and carbon emissions.

Project Description:

This project develops and demonstrates standardized energy efficiency retrofit packages, specifically geared towards the low-income multifamily housing market, and that can be scaled to drive down costs. As part of the agreement, the recipient will develop a business model for these packages to overcome financing challenges.

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

Significant improvements in speed and cost reductions of retrofit packages are critical to realizing mass-scale deployment of retrofits. Even when pairing grants from the State's Low-Income Weatherization Program (LIWP) for multifamily buildings, it is rare that those retrofit projects alone can achieve ZNE. The key to bringing costs down and construction speeds up is to simultaneously address the technical and business model barriers that exist in the market. Some of the innovative approaches to be considered include: modularized, pre-fabricated, pre-insulated building enclosures; packaged multi-function heat pumps for heating and cooling; energy recovery ventilation; advanced heat pump water heaters; and behavior modification technologies and strategies.

These approaches hope to speed up implementation, bring down retrofit costs, and integrate them into programs, such as LIWP.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Demand Response (DR): R.13-09-011 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 2a, 3a, 3b, 3f

Lower Costs: One out of every three low-income families report facing challenges in paying their energy bills, which could include forgoing purchasing food or keeping their apartments at unsafe temperatures. This project could result in the potential for a fixed energy expenditure and allow for potential cost savings to building owners as the cost of retrofit solutions come down due to mass scaling. There is also potential for tenants to financially benefit from taking part in additional revenue streams such as demand response programs.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,555,647

EPIC Funds Encumbered:

$7,204,308

EPIC Funds Spent:

$181,018

Match Partner and Funding Split:

Association for Energy Affordability: $6,499,062 (46.7 %)

City of San Francisco Department of Environment: $900 (0.0 %)

Stone Energy Associates: $700 (0.0 %)

Rocky Mountain Institute: $204,646 (1.5 %)

Match Funding:

$6,705,308

Leverage Contributors:

California Multifamily LIWP: $6,200,000

Leveraged Funds:

$6,200,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

18 out of 18 bidders

Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, Rocky Mountain Institute, formerly one of the subs, became the prime, and Prospect Silicon Valley, formerly the prime, became a subcontractor. As a result of this change, two teams were created: the technical team and the market solutions team. The technical team is working on an Emerging Technologies Assessment Criteria which outlines how technologies will be evaluated and also on evaluating the current multifamily building stock in California to identify ideal types of buildings for the proposed retrofit approach. The market solutions team is working on identifying and overcoming market barriers for wide-scale deployment of retrofits for multifamily buildings. Rocky Mountain Institute has submitted a proposal to a Department of Energy (DOE) funding opportunity and if awarded will leverage DOE funds to help the development of the CEC project.

Project Name: EPC-17-041 - Lead Locally

Recipient/Contractor: Sonoma Clean Power Authority

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/1/2018 to 6/30/2022

Program Area and Strategic Objective:

Applied Research and Development, Technology Demonstration and Deployment

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors., S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Substantial potential for efficiency improvements remains untapped in the existing building stock, but effective strategies that generate widespread consumer interest and adoption have yet to be implemented. The specific challenges of doubling efficiency by 2030 will depend on:

- Expanding adoption of energy efficiency upgrades that go beyond existing codes and standards.
- Advancements in technologies to increase performance and reduce equipment and labor costs.
- Innovative deployment and funding strategies, business models and private/public partnerships and informed decision-making to spur mass adoption and scale-up.

Project Description:

This project is evaluating and demonstrating strategies to increase retrofits of existing buildings and includes the following elements: 1) identification and pilot testing of promising emerging efficiency technology packages for cost-effectiveness, feasibility, and customer acceptance; 2) development of an "Energy Marketplace" where consumers can directly procure technologies appropriate for their buildings. This will be combined with financing and rebates. The program targets those with little to no upfront capital and are the most difficult to reach. Training will be offered to contractors, realtors, and building officials with the goal of greatly increasing customer knowledge, decreasing code violations, and increasing penetration of energy efficiency measures outside the framework of utility programs.

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

The project could increase market penetration for existing building retrofits and result in deeper savings per site using the existing program funding that Sonoma Clean Power and the investor-owned utilities will allocate in future years. The project anticipates providing a full range of options for customers--from whole building integrated retrofits to partial retrofits and traditional equipment upgrades, depending on the customer's interest, budget, and need. The high level estimated net present value of the project benefits is over $60M in 2030. Additional benefits could be realized if fuel-switching strategies that are being evaluated as part of the applied research phase of the project meet cost-effectiveness, feasibility, and customer acceptance criteria and can be included in the Energy Marketplace.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h

Lower Costs: Lower costs could be achieved through a dual approach of directly reducing customer utility bills through installation of energy efficiency measures and decreasing implementation costs by providing training and direct customer access. This project goal is to deliver site electric savings of 10% for residential and 20% for commercial properties. The recipient is currently conducting installations of specific technologies.

Greater Reliability: Greater electricity reliability will be established through electricity savings, tailoring program measures to those that will best reduce peak kW usage and grid challenges in the Sonoma Clean Power service territory. Additionally, many of the strategies investigated in the applied research phase have the ability to integrate into the existing Sonoma Clean Power DR platform for additional grid reliability gains.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$4,687,705

EPIC Funds Encumbered:

$9,814,596

EPIC Funds Spent:

$1,842,821

Match Partner and Funding Split:

Sonoma Clean Power Authority: $3,335,500 (25.4 %)

Match Funding:

$3,335,500

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

18 out of 18 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has submitted a set of interim reports on project evaluation, measurement and verification (EM&V) frameworks. These reports summarize the team's detailed plans for instrumentation, monitoring, and EM&V process for each technology demonstration considered under this project. The demonstration enrollments and installations, and performance measurements for these technologies will be conducted through Q1 2021. The renovations for the Energy Marketplace is delayed and the grand opening is expected to be around Q2 2020. The project was featured at the 2019 ACEEE Hot Water Forum, and the CPUC-CEC Joint Agency Workshop on Building Decarbonization on 4/8/19. The official website of the program can be found at sonomacleanpower.org/lead-locally.

Project Name: EPC-17-042 - Camptonville Biomass-to-Energy Project

Recipient/Contractor: Camptonville Community Partnership, Inc

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 1/27/2020 to 3/31/2024

Program Area and Strategic Objective:

Technology Demonstration and Deployment

4.4 Improve the Value Proposition of Bioenergy

Issue:

California is experiencing unprecedented levels of tree die-off. Factors that are contributing to the die-off include several consecutive years of drought, warmer temperatures, and an infestation of bark beetles. The dead tree population in California greatly exceeds the level expected for healthy forests, and this overabundance of forest fuel increases the risk of catastrophic wildfires that threaten property and lives. Bioenergy is captured as one solution to help manage forest biomass volumes; however, there is a need to demonstrate technologies that can economically convert biomass to electricity.

Project Description:

The project will demonstrate an innovative 5.5 MW biomass power plant located in Camptonville, California that will:

- Produce a replicable power plant design that can help reduce costs for future plants, and accelerate adoption of comparable capacity biomass plants at other California locations.
- Demonstrate a robust direct combustion technology that has the flexibility to utilize diverse biomass feedstock available throughout California.
- Validate significant reductions in NOx, CO, and VOC emissions.
- Reduce water consumption required for biomass power generation.
- Increase availability of renewable electricity and grid reliability while reducing emissions and wildfire threats.

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

The plant's key technologies have been successfully used as individual components, but they have not been demonstrated as an integrated system at the relatively small scale (5 MW net) intended for this project. The innovation for this project is to design and build a 5.5 MW forest biomass-to-electricity power plant using an advanced emissions control and low water use condenser. The facility is estimated to consume 50,000 bone dry tons of woody biomass annually, which will be derived from dead and diseased trees and

forest byproducts harvested from public and private forested lands near Camptonville, California.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

SB 1122 Bioenergy feed-in tariff: R.11-05-005 Renewables Portfolio Standard Program: R.18-07-003

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

Greater Reliability: Power will be exported to PG&E, which will help increase grid reliability in rural regions near Camptonville and the surrounding foothill communities.

Increase Safety: By utilizing dead and diseased trees and forest byproducts, this project will reduce the risk of catastrophic wildfires, thereby mitigating threats to people and property.

Economic Development: The Camptonville project will create living-wage jobs in economically distressed Sierra Nevada communities by demonstrating a successful business model for biomass utilization. The Camptonville plant is estimated to create up to 27 full time new jobs. This employment increase is expected to cut the unemployment rate in the community by more than 50% (decrease from nearly 9% to about to 4%).

Environmental Benefits: The Camptonville project will generate power using advanced emissions controls that will keep NOx, CO, and VOC emissions well within air district limits. In addition, the project will use an advanced condenser for heat rejection that will significantly reduce water consumption.

Consumer Appeal: This project is a community-based initiative that has many supporters, including local community organizations and agencies, environmental organizations, regional timber operators, county and State government representatives and agencies, Federal land management agencies, and several air quality management districts.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$110,031

EPIC Funds Encumbered:

$4,999,830

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Phoenix Energy: $13,030,225 (72.3 %)

Match Funding:

$13,030,225

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders

Rank of Selected Applicant / Bidder:

Ranked # 4

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project was initially approved the October 2018 Business Meeting and again at the January 22, 2020 Business Meeting because of project revisions. This most recent approval was to change the prime grant recipient to Camptonville Community Partnership after the original prime recipient and a major subcontractor withdrew from the project. Otherwise, the project itself, the Camptonville Biomass-to-Energy Project (aka Forest Biomass Business Center Bioenergy Facility - Gellerman Site), including the scope, has not changed. The agreement execution is in process and anticipated to be completed before the end of February 2020.

Project Name: EPC-17-043 - GLOW: A User-friendly Interface for GridLAB-D

Recipient/Contractor: Hitachi America LTD

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

GridLAB-D is an open-source electric system simulation tool developed by the U.S. Department of Energy. It is used by the electric power industry to support policy development and to address planning and operational needs, including simulating distributed energy resource impacts on the electric system. However, it has an antiquated user interface, which requires users to memorize command lines and build scripts in languages such as Python to enter data into the simulation tool. An intuitive interface would significantly improve the use of this powerful tool for power system simulation in California.

Project Description:

This project is developing GridLAB-D Open Workspace (GLOW), an intuitive interface for GridLAB-D that will provide a user-friendly environment for researchers, planners, developers, and regulators involved in advanced electric grid technology simulation and scenario analysis. The interface will simplify data input and simulations, enable visualization of complex information, and be scalable for big data simulations. GLOW will be a freely available and widely supported open-source tool based on existing GridLAB-D technology.

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

The technical advancement of the project is the development of an intuitive and widely available user interface for GridLAB-D, a software simulation tool for advanced distribution system simulation and analysis developed by the U.S. Department of Energy.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013

Applicable Metrics: CPUC Metrics- 3b, 3c, 5b

Lower Costs: Lower simulation and analysis costs will be achieved by developing a new, intuitive and convenient user interface, which will reduce the high costs of training due to the current, cumbersome and challenging interface of GridLAB-D. The improved interface will lower the barrier to widespread use.

Greater Reliability: Greater electricity reliability is achieved by improving distribution planning through grid simulation and analysis to determine impacts of distributed energy resources and controllable loads on distribution networks and substations. The development of a user interface will increase access to simulation and analysis results for advanced power system solutions by technology developers, researchers and public agencies.

Consumer Appeal: Consumer appeal is achieved by developing a user interface that is intuitive and more convenient to non-expert users. This will result in GridLAB-D becoming more widely adopted due to the increased ease of use and lower level of training required to perform simulations using a simple user interface.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$193,906

EPIC Funds Encumbered:

$2,999,699

EPIC Funds Spent:

$1,168,828

Match Partner and Funding Split:

Hitachi America LTD: $1,175,060 (27.6 %)

National Grid: $80,000 (1.9 %)

Match Funding:

$1,255,060

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 4: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team completed their specifications for GLOW and has started working on the graphical user interface development. They showcased what they have developed so far and are working with investor owned utilities under a nondisclosure agreement to help confirm and validate the integrated capacity analysis. Once validated, the use case will provide a skeleton to branch to other use case scenarios including but not limited to: tariff design, grid resilience, and distribute energy resource growth scenarios.

Project Name: EPC-17-044 - Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California

Recipient/Contractor: InTech Energy, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/13/2018 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development, Technology Demonstration and Deployment

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors., S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Wide-scale energy efficiency retrofits lag behind technical and market potential. Utility programs are often difficult to participate in, and commercial customers lack the knowledge to understand how to plan for and finance a complex retrofit on their own. This leads to unrealized retrofit projects and energy waste and untapped economic benefits. Increased energy efficiency adoption depends on customer engagement and education, as well as cost effectiveness of the programs to get projects to customers.

Project Description:

The project objective is to develop a web-based marketplace platform for connecting customers with energy service providers, technologies, and lenders; installing retrofits at a variety of commercial customer sites in southern California, evaluating the pay-for-performance concept. This includes financing components to offset customer costs, insurance markets to reduce perceived risk for lenders, and a sales-as-a-service marketplace where efficiency products and services are connected with sales professionals.

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

This project hopes to accelerate the adoption of market-driven, pay-for-performance retrofits at commercial customer sites by maximizing market potential using Sales-as-a-Service marketplace where customers, products and supporting services can connect with industry professionals. Through this marketplace, the value of energy efficiency will be standardized and transparent, lowering cost and time to implement these technologies. The combination of these methods, along with new energy efficiency technologies in the demonstration sites, will showcase how cost-effective, energy-efficient solutions can be provided in a timely fashion.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Lower Costs: This project hopes to lower energy costs for commercial customers. It is estimated that equipment integration and installation costs can be reduced by ~80%. The benefits include energy savings from energy efficiency measures, and integration with utility demand response programs to capture the benefits of time-dependent utility pricing.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$2,139,730

EPIC Funds Encumbered:

$7,199,315

EPIC Funds Spent:

$578,247

Match Partner and Funding Split:

InTech Energy, Inc.: $2,600,274 (26.5 %)

Match Funding:

$2,600,274

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

18 out of 18 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project is currently on hold pending a review of the project objective and scope.

Project Name: EPC-17-045 - Oak View Microgrid: Using Microgrid Technologies to Simultaneously Improve Quality of Life and Electric Grid Operations

Recipient/Contractor: The Regents of the University of California, Irvine Campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/16/2018 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

Disadvantaged communities suffer disproportionally from the environmental impacts of energy conversion. Microgrid technologies can reduce these impacts, helping combat poor air quality while also improving grid performance and resiliency. Currently, there are no standard methodologies for microgrid design that simultaneously consider air quality, grid reliability, and grid resiliency. In addition, there is a dearth of experience in designing microgrids while also improving building energy efficiency and retrofitting at a reasonable cost.

Project Description:

This project develops multiple urban energy scenarios (UES) in which multiple types of energy efficiency, electrification, and microgrid technologies are considered. The design approach uses integrated methods that simultaneously consider various technology and retrofit options, while also verifying that the proposed technology mixes accomplish the goals of improving air quality and grid operations. The work will result in the proposal of a microgrid design ready for implementation in Oak View and an extensible and robust design methodology that can be used throughout the state for economic and environmentally sensitive microgrid development.

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

This project is advancing the integration of emerging and proven sustainable energy technologies with various end uses in the Oak View community, helping to facilitate the implementation of SB 535 and AB 1550 that require maximizing benefits from low-carbon technologies to disadvantaged communities. For the first time, this study is assessing ways to reduce particulate matter, nitrogen oxides, and other indoor and outdoor air pollutants associated with appliances used in homes and with electricity generated and served to the subject community. The research team is using big data to develop decarbonization pathways for the community energy system that will include increased energy efficiency improvements within existing residential buildings, renewable energy

generation and energy storage technologies, vehicle electrification, and electrification of natural gas appliances.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007 Strategies and Guidance for Climate Change Adaptation: R.18-04-019

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

Lower Costs: The microgrid design is intended to decrease transmission and distribution losses and reduce the need for new transmission infrastructure.

Greater Reliability: The microgrid design developed under this project is expected to serve the critical loads inside a community without interruption, provide ancillary services to the grid during normal operations, and provide black-start capability.

Public Health: The designed microgrid is expected to reduce greenhouse gas emissions and criteria pollutant emissions, leading to improved air quality and providing health benefits to communities.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$157,594

EPIC Funds Encumbered:

$1,099,760

EPIC Funds Spent:

$151,139

Match Partner and Funding Split:

National Renewable Energy Laboratory (NREL): $118,000 (8.0 %)

Altura Associates, Inc.: $20,000 (1.4 %)

County of Orange/City of Huntington Beach: $20,000 (1.4 %)

Advanced Power and Energy Program (APEP) - University of California, Irvine: $209,804 (14.3 %)

Match Funding:

$367,804

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

28 out of 29 bidders

Rank of Selected Applicant/ Bidder:

Group 2a: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team has been developing an optimization software tool, known as DERopt, which models distribution system operations and helps users select an optimal mix of energy efficiency, electrification, and microgrid technologies for a given community to achieve its desired outcomes. The team will use this tool and additional methodologies to develop the UES for consideration in the project. The team has also been collecting "big data" about the built environment and energy consumption behavior in the Oakview community. The researchers described the types of data collected in the Built Environment and Energy Consumption Report; they include the current building stock, building vintage, building end use, electrical and natural gas energy use, and the mapping of local energy utility infrastructure.

Project Name: EPC-17-046 - HiPAS GridLAB-D: A High-Performance Agent-based Simulation using GridLAB-D

Recipient/Contractor: SLAC National Accelerator Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

GridLAB-D is an open-source electric system simulation tool developed by the U.S. Department of Energy. It is used by the electric power industry to support policy development and to address planning and operational needs, including simulating distributed energy resource impacts on the electric system. However, GridLAB-D software does not take advantage of modern computing hardware (i.e., parallel processors). This results in extremely slow processing time for electric system simulations, increasing the time and cost of evaluating multiple scenarios, which is necessary for policy development and operational planning.

Project Description:

The High Performance Agent-Based Simulation (HiPAS) GridLAB-D project will increase the performance of the open-source version of GridLAB-D and improve the broad accessibility of high-performance power grid simulation capabilities to the community of smart grid and distribution simulation users in California. HiPAS includes methods that parallelize many of the iterative methods used in simulations. HiPAS is intended for both desktop multi-core processors and cloud platforms. It will enable GridLAB-D users to more efficiently analyze multiple scenarios with improved resolution by reducing the computational costs associated with analysis.

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

The project will achieve technology advancement and usability breakthroughs in the following performance areas: 1) Granular object-level parallelization of computations; 2) Large-scale parametric job control; 3) Sensitivity analysis; and 4) Monte Carlo analysis. These advancements will improve the accessibility and applicability of GridLAB-D to California utilities, government agencies, and researchers who are responsible for system policy, planning, operation and oversight in the presence of growing customer-based demand response and renewable energy resources.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Resource Adequacy (RA) 2016 and 2017 Compliance Years: R.14-10-010 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1a, 1b, 3a, 5b

Lower Costs: HiPAS GridLAB-D will address the primary barriers to analyzing more grid locations for distributed energy resource deployment, by reducing the computational costs associated with these kinds of analyses. This will reduce the cost for interconnection studies.

Greater Reliability: The HiPAS enhancements to GridLAB-D achieved through this project will increase utility analyst productivity in performing distributed energy resource integration studies by improving the accuracy and timeliness of results supporting interconnection and grid planning.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$1,149,270

EPIC Funds Encumbered:

$3,068,781

EPIC Funds Spent:

$1,976,439

Match Partner and Funding Split:

National Grid: $300,000 (8.9 %)

Match Funding:

$300,000

Leverage Contributors:

U.S. Department of Energy: $6,000,000

U.S. Department of Energy: $150,000

U.S. Department of Energy: $580,000

Leveraged Funds:

$6,730,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team developed the requirements and design for the HiPAS project. They worked on implementing these requirements and updating modules with more accurate and granular capabilities including commercial and residential buildings, markets, database, and power flows. They also supported core system development, workflow and format support requirements for two other EPIC funded modeling projects: GLOW and OpenFIDO. As for accelerating simulations, they are looking into machine learning to bypass unneeded computations.

Project Name: EPC-17-047 - OpenFIDO: An Open-source Framework for Integrated Data Operations

Recipient/Contractor: SLAC National Accelerator Laboratory

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 5/11/2018 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid.

Issue:

Various tools are used in distribution planning. They come from a diverse number of suppliers and do not work within a single user framework to interact and share information. Utility planners and grid researchers need a tool and integration framework to quickly move data from one application to another as part of their engineering, planning, and review activities. Enabling the sharing of information across distribution planning tools will save time and money.

Project Description:

This project will develop OpenFIDO, an open source tool to transfer data between various programs that are part of the suite of tools used in by utilities, distributed energy resource (DER) engineers and regulators in California. The tool is an integration framework to quickly move data from one application to another as part of their engineering, planning, and review activities.

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

Current grid simulation tools do not support the exchange of data to other programs. This is not sufficient when many different tools are used to analyze the many multi-disciplinary problems energy system researchers, analysts and regulators must address. OpenFIDO proposes to use an open multi-standard approach to data exchange called polyglot representation. This approach allows data to be exchanged so that data sets of commercial buildings, retail tariffs, and distribution networks can be reliably exchanged between the various distribution system analysis and simulation tools that are currently used. This enables better analysis of the impacts of DERs in distribution planning.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Integration of Distributed Energy Resources (IDER): R. 14-10-003

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

Lower Costs: The capabilities of OpenFIDO will help grid simulators more reliably and efficiently exchange system data sets with analysts, regulators, vendors and others who perform grid simulation and analysis. The reduction in labor intensity and staff training by using this framework will improve productivity, to lower overall costs.

Greater Reliability: Determination of the grid impacts of DERs requires multiple iterations of power flow analysis, which utilities perform as part of their interconnection studies. This requires analysis using multiple tools that must exchange data. Greater data exchange will enable deeper analysis of the impacts of DERs and the measures to limit those impacts to maintain and increase reliability.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$367,282

EPIC Funds Encumbered:

$1,000,000

EPIC Funds Spent:

$606,989

Match Partner and Funding Split:

National Grid: $30,000 (2.9 %)

Match Funding:

$30,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team completed the design for the data exchange tool. The project team also conducted a workshop and TAC meeting in September 2019. The project team presented updates on data imports and requirements documentation. Attendance at both the workshop and meeting, included representatives from CPUC, PG&E, SCE, PNNL, SunRun, Kevala, and National Grid. Attendees provided a large amount of feedback regarding the various needs and applications for OpenFIDO. Possible applications included integrated capacity analysis, tariff designs, and electrification.

Project Name: EPC-17-048 - Engaging Communities in the Design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/16/2018 to 6/30/2022

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

Interdisciplinary analysis is critical for understanding the potential for energy transformation around the interface of dense urban environments with agricultural lands, communities, and natural resources. This research specifically addresses the people and communities most affected by development in these "urban-agriculture interface zones." This project aims to advance the engagement of communities in the design of Sustainable Energy and Localized Futures (SELF) models in California's San Joaquin Valley.

Project Description:

Through the analysis of "big data" comprising remotely-sensed images (e.g. agriculture lands, road networks, and built environment) and Geographic Information System (GIS) layers (e.g. energy consumption, distribution networks, new build construction, reserve areas, and planning documents), the project team is developing an analysis that examines specific dense urban areas with both high potential for retrofits that can help meet the needs of disadvantaged communities. Through the identification of critical "Urban-Agriculture Interface Zones" using a GIS-based hot spot analysis across the Southern San Joaquin Valley, the project identifies and engages with communities (with community-based organizations) to conduct SELF modeling. This project identifies opportunities in the SELF communities for efficiency and energy system improvements based on analysis of energy optimization tools such as the Solar, Wind, Investment in Technology, Hydropower (SWITCH) model. An optimization model is being developed for these densely populated zones to design "SELF- SWITCH" systems (SELF-SWITCH model).

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

This research is advancing the state of the art by developing a new model that can explore the cost and feasibility of generation, transmission, and storage options for the

future electricity system in a sub-regional environment. The model identifies cost-effective investment decisions for meeting electricity demand, taking into account the existing grid as well as projections of future technological developments, renewable energy potential, fuel costs, and public policy. Integrating this model with updated GIS and geographically relevant data and algorithms for a sub-regional development will assist California's energy system planners.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Identify Disadvantaged Communities in the San Joaquin Valley and Provide Economically Feasible Options for Affordable Energy: R.15-03-010

Applicable Metrics: CPUC Metrics- 3a

Lower Costs: The project will lower long-term costs through identification of transformational system upgrades that will deliver less costly energy services in dense urban zones.

Greater Reliability: The project will result in the ratepayer benefits of greater reliability by identifying environmental and system risks of meeting transformational and system upgrades in the Southern San Joaquin Valley region.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$228,397

EPIC Funds Encumbered:

$1,100,000

EPIC Funds Spent:

$53,161

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

28 out of 29 bidders

Rank of Selected Applicant/ Bidder:

Group 2b: Ranked # 2

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The research team has developed an initial review of relevant models relating to energy systems and land use including a review of open-source modeling platforms and applications. The research team has also developed a draft ("beta") SELF Github site that will provide open and available data for the SELF project, including: 1) GIS Enviroscreen data layers; 2) Tiger Shapefiles and boundary layers; 3) road and infrastructure network layers; 4) land use and designated places layers; 5) San Joaquin Valley unincorporated communities and estimated population layers; 6) infrared radiometer data layers; and 7) draft Rscript for running calculations on existing data. The team continues to develop a framework to guide surveys and other inputs for informing the GIS and modeling processes.

Project Name: EPC-17-049 - Port of San Diego Microgrid - Resiliency in Terminal Operations

Recipient/Contractor: San Diego Unified Port District (Port of San Diego)

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/13/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

California ports are electrifying their operations to move toward zero emission operations. The move to all-electric terminals will result in many terminals at least tripling their peak power consumption, while becoming more susceptible to operational disruptions due to losses of grid power. Renewable microgrids provide a potential path to a carbon-free, resilient, and sustainable energy solution while reducing the effects on the utility's distribution system. Demonstration of the operational and financial viability of a replicable microgrid model will add significant value to California ports, while helping increase the penetration of distributed energy resources.

Project Description:

The project will develop a new, permanent, renewable microgrid at the Tenth Avenue Marine Terminal that can be replicated at other seaport terminals and distribution facilities throughout California, the U.S., and internationally. The project will incorporate solar photovoltaic renewable generation, battery energy storage, energy efficiency improvements, and a centralized microgrid controller to allow key elements of the terminal to remain operational when islanded from the electrical grid for a minimum of 12 hours. The proposed microgrid will test the integration of four distributed energy resources.

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

The project will develop a solar-powered, resilient microgrid that will provide power to critical loads and allow key elements of the terminal to remain operational for 12 hours or longer when islanded from the grid.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013

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

Lower Costs: The project will lower ratepayer costs by reducing the need for electric utility infrastructure improvement through consistent management of peak demand. The project will investigate different options to reduce capital investments and document cost effective options for ratepayers implementing similar projects.

Increase Safety: The microgrid will increase energy resiliency resulting in a safer staging area that can be used for emergency relief, supplies, and fuel in the event of a disaster that causes a disruption to the electrical grid.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$422,043

EPIC Funds Encumbered:

$4,985,272

EPIC Funds Spent:

$0

Match Partner and Funding Split:

The Regents of the University of California, San Diego: $201,963 (2.1 %)

San Diego Unified Port District (Port of San Diego): $4,427,973 (46.1 %)

Match Funding:

$4,629,936

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

54 out of 60 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 5

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The Port has achieved advanced stages of microgrid system design, developed bid documents and initiated a best value public procurement process for the microgrid systems. Key learnings include challenges associated with evaluating microgrid whole of life project costs under a public procurement process. In parallel, the Port has begun warehouse roof replacement work to support the solar PV array installation, as well as energy efficient lighting installation work.

Project Name: EPC-17-050 - Using Big Data to Holistically Assess Benefits from Building Energy System Transition Pathways in Disadvantaged Communities

Recipient/Contractor: The Regents of the University of California, on behalf of the Los Angeles Campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/11/2018 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

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

Issue:

There is a need to better understand effective approaches for conducting holistic energy planning for urban areas in California. This study is designed to developed an approach that could be replicated in other urban areas.

Project Description:

This research project supports holistic urban energy planning for the Avocado Heights community that simultaneously considers urban renewables, indoor and outdoor air quality, deep energy efficiency options, retrofitting of homes and buildings, electrification, and issues of environmental justice.

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

Energy planning is often conducted in a piecemeal fashion, focusing on opportunities relevant to individual market sectors or fuels. This project is taking a different approach, using a holistic approach for urban energy planning with the final goal of identifying economically attractive options for deep GHG reductions and improved environmental conditions in Avocado Heights.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Long-Term Procurement Proceeding (LTPP): R.13-12-010 (closed) Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 4a, 4b

Lower Costs: The research team is developing urban energy scenarios to examine pathways to economically reduce greenhouse gas emissions and improve overall environmental conditions.

Environmental Benefits: The research team is estimating the best way to improve outdoor air quality and reduce GHG emissions in the studied urban area.

Public Health: The research team is measuring indoor air quality conditions to determine the indoor air quality benefits of electrification.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$233,968

EPIC Funds Encumbered:

$1,098,662

EPIC Funds Spent:

$56,773

Match Partner and Funding Split:

Regents of the University of California, Los Angeles: $54,740 (4.7 %)

Match Funding:

$54,740

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 29 bidders

Rank of Selected Applicant / Bidder:

Group 2a: Ranked # 1

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

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has assembled a multi-disciplinary research team that has expertise spanning public health, energy engineering, and public engagement. The research is being carried out in close collaboration with community-based representatives; this allows the research team to elicit community perspectives and effectively integrate community objectives. The research team has conducted two field studies measuring ambient air quality conditions.

Project Name: EPC-17-051 - LEED: A Lightwave Energy-Efficient Datacenter

Recipient/Contractor: The Regents of the University of California, on behalf of the San Diego campus

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/18/2018 to 1/31/2020

Program Area and Strategic Objective:

Applied Research and Development

S11: Provide Federal Cost Share for Applied Research Awards.

Issue:

Increasing the Power Utilization Efficiency (PUE) of a data center will not increase the overall datacenter energy efficiency. Further improvements in the energy efficiency of a datacenter require directly addressing the energy utilization of each server. Based on current trends, this is a challenging problem because the rate at which datacenter traffic is increasing is much larger than the rate at which packet switch chip bandwidth is increasing. This means that future datacenters will require more switch chips and constantly more power, to support the ever-increasing data rate.

Project Description:

The goal of this federal cost share grant, the Lightwave Energy-Efficiency Datacenter (LEED) program, is to at least double the current energy efficiency of a datacenter. This dramatic improvement is realized by increasing the energy utilization of each server by means of a novel lightwave network. The LEED network can substantially increase the network bandwidth which leads to a corresponding improvement in the server energy utilization. This improvement can be realized at a cost comparable to a state-of-the-art datacenter network based on conventional electrical switching technologies.

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

This project could lead to technological advancement in lightwave technology for datacenters. It could double the efficiency of datacenters by increasing the speed of response and reducing energy input.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

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

Consumer Appeal: This technology uses optical switches in the server hub increasing data transferring speeds and energy efficiency making it very appealing to data centers.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$78,440

EPIC Funds Encumbered:

$475,000

EPIC Funds Spent:

$412,178

Match Partner and Funding Split:

None

Match Funding:

$0

Leverage Contributors:

U.S. Department of Energy: $3,800,000

The Regents of the University of California, San Diego : $491,524

Axalume: $127,000

National Science Foundation: $225,000

Leveraged Funds:

$4,643,524

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

43 bidders

Rank of Selected Applicant / Bidder:

N/A

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

The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has completed the project and successfully developed its optical switch and the necessary transmitter and receiver to revolutionize data centers. Currently, fiber optical lines are used for internet, but data centers are still using electrical lines to each data center rack. Using light signals in the optical switches is expected to increase energy efficiency by 50% and would be able to process data a lot faster. The data processing speed is one of the main driving factors in consumer appeal for data centers and should be easily marketed in the data center industry. Recipient is seeking additional funding to further the technology development.

Project Name: EPC-17-052 - Urban Microgrids for Grid Resiliency and Disaster Readiness

Recipient/Contractor: Gridscape Solutions

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 7/18/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Critical facilities such as fire stations, 911 call centers and community service centers cannot afford to be without power, even for a moment. The aging nature of the grid and limited funding for critical facilities' operation have made disadvantaged communities particularly vulnerable and more susceptible to outages caused by natural disasters such as wildfire, severe weather, or earthquakes. Disadvantaged communities need better, resilient infrastructure such as microgrids to help support critical operations.

Project Description:

This project is developing adoptable microgrid for disaster-readiness, resiliency, and grid services and will deploy them at least five demonstration sites in DAC areas and two different IOU service territories. It will also connect multiple customer-owned behind-the-meter DER assets into virtual networks of microgrid via cloud-based controls and optimization platform.

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

This project is leading to technological advancement and breakthroughs by developing and demonstrating the ability to remotely operate multiple microgrids, which can be useful for keeping all critical functions operational in the event of a grid outage, reducing utility costs, and minimizing the reliance on diesel backup generators.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Distribution Resources Plans (AB 327): R.14-08-013 Distribution Level Interconnection (Rule 21): R.11-09-011 (closed) Integration of Distributed Energy Resources (IDER): R. 14-10-003

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

Lower Costs: This project is demonstrating a business case for applying microgrids to critical facilities, by showcasing the energy cost reductions that make these systems economical for local governments.

Greater Reliability: This project provides orderly and multi-purpose integration of renewable generation at distributed sites, which benefits the ratepayer with greater reliability and resiliency at lower costs.

Increase Safety: Each microgrid will be able to island during a utility outage or natural disaster such as a wildfire or earthquake and provide emergency power to critical loads for more than 3 hours using renewable solar generation and battery storage technology.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$562,214

EPIC Funds Encumbered:

$4,995,498

EPIC Funds Spent:

$323,976

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $429,752 (5.2 %)

TRC Energy Services: $10,074 (0.1 %)

InTech Energy, Inc.: $15,000 (0.2 %)

Gridscape Solutions, Inc.: $260,666 (3.1 %)

Match Funding:

$3,281,992

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

54 out of 60 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

A standardized third generation Gridscape EnergyScope Microgrid System (Microgrid-in-a-box), which integrates a battery energy storage system, interconnection relay, inverter, controller, and other components was developed, built and installed for testing in the Gridscape lab in Fremont. This system can be scaled-up or scaled-down for the energy need of any site. A direct purchase agreement with the City of Fontana was executed in May 2019 to deploy five microgrids at the city hall, police headquarters, community senior center, community service center, and public works department. The City of Fontana Microgrids are in the design phase and expected to be completed in the third quarter of 2020. Gridscape is also in the process of finalizing sites selections in two other Cities for microgrid deployment.

Project Name: EPC-17-053 - Santa Rosa Junior College Urban Microgrid Project

Recipient/Contractor: Sonoma County Junior College District/ Santa Rosa Junior College

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 9/27/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Academic campuses are particularly interested in maintaining critical functions in the event of a grid outage, notably during and after a disaster event. The functions primarily support the students, faculty and staff but could provide support to the broader community. Microgrids have the potential to provide important resiliency benefits, especially in an area prone to disasters such as wildfires; however, it is difficult to justify their cost on resiliency alone and to build a business case for the development and deployment of a microgrid.

Project Description:

Santa Rosa Junior College (SRJC) will demonstrate a microgrid on campus. This project will integrate three types of distributed energy resource (DER) elements: solar photovoltaic (PV) generation, energy storage, and load reduction devices and load control systems, all managed by a single microgrid controller. The goals of this project are to meet 40% of the campus electricity requirement with emissions-free PV solar power, to reduce the campus peak load, to optimize energy use, to provide support services to the surrounding grid, and to create a highly resilient power system benefitting the campus and the community. This project will demonstrate the environmental, economic, and resiliency benefits of a highly flexible campus microgrid. Operational objectives encompass demonstration of power flow, load control, and energy storage in a large multi-building campus, operating at appropriate scale and in actual operating conditions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will result in advancements in the deployment of a microgrid, including the use of storage technologies, adaptive load management, and the monetization of microgrid assets while providing community support facilities in times of need. This project will also demonstrate coordination of multiple large energy storage devices with different dynamic capabilities. By demonstrating a local approach to stabilizing utility grid

frequency, the microgrid will be transformed from a source of load transients to a point of stabilization reaching far beyond the point of interconnection.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed)

Applicable Metrics: CPUC Metrics- 1c, 1g, 1h, 2a, 3f, 3h, 4a, 4b, 5a, 5b, 5d

Lower Costs: The microgrid will reduce costs for the school by lowering peak demand charges and energy costs through on-site generation and storage. It will also reduce costs of lost operation by allowing the campus to remain open for classes during grid outages. The project will benefit the utility and ratepayers by providing local voltage support and frequency regulation, thus allowing the distribution grid to rely less on centralized local power electronics to provide these services.

Greater Reliability: Power quality will be improved on both the college campus and local distribution system through demonstration of dynamic frequency regulation and voltage control technologies. With the ability to provide both real and reactive power and to respond autonomously to changing grid needs, the project will be capable of providing grid stabilization to the local distribution feeder. The project will provide back-up power to the school in the event of an outage.

Increase Safety: The project will provide back-up power to the school campus in the event of grid outages, thereby improving the safety of staff, students, and potentially local residents.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$348,244

EPIC Funds Encumbered:

$4,999,005

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Sonoma County Junior College District/ Santa Rosa Junior College: $239,000 (1.7 %)

SunPower Corporation, Systems: $8,450,759 (61.7 %)

Match Funding:

$8,689,759

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

54 out of 60 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 3

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The design team has finished the submeter drawings, which are read-only meters. The steel structure for the Zumwalt Solar Carport Structure has been completed and solar panels have been installed, so now all three PV parking structure installations are complete and operational. The team started the microgrid modeling using Xendee software. The team has begun working with PG&E on the design for new point of interconnection switchgear, with discussions about project goals and where they can interface with PG&E to work together.

Project Name: EPC-17-054 - Rialto Resilient Clean Power Microgrid

Recipient/Contractor: Rialto Bioenergy Facility LLC

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/31/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Presently, microgrid system deployment at facilities that manage wastewater, wastewater biosolids, or food waste, is very uncommon. Microgrids have the potential to optimize onsite power management, enhance power export, and provide other grid and ratepayer benefits which can reduce the overall operational costs of these facilities and enable them to operate in the event of a grid outage. Additionally, California has a goal of diverting 75 percent of waste from landfill disposal by 2020, as called for by AB341; anaerobic digestion to convert waste into energy is part of the solution.

Project Description:

The project will install an advanced microgrid system that will include 2.0 MWh of battery electric storage, a 2.0 MW biogas-fueled cogeneration unit, and a microgrid control system at the Rialto Bioenergy Facility (RBF). The microgrid will manage the distributed energy resources to meet loads at the RBF, while minimizing grid draw and enhancing renewable electricity export. Additionally, the microgrid will enable the operations to continue indefinitely in the event of a grid outage using available feed stock (i.e., food waste and biosolids).

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will demonstrate the business case for a microgrid that can improve operations of a food and biowaste treatment facility, as well as a wastewater treatment facility, located in a disadvantaged community. The microgrid will use a microgrid controller to optimize a biogas cogeneration system, fueled by available feedstock, and utilize energy storage to enable the facility to continue operations during a grid outage. This project will demonstrate the microgrid's ability to provide benefits to the residents of the disadvantaged community by providing opportunities to participate in demand response activities, providing cleaner air quality, and increasing grid reliability and resiliency. The business case could be applicable to the 156 critical waste water treatment plants across California.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed)

Applicable Metrics: CPUC Metrics- 1b, 1e, 1f, 1h, 4a, 4b, 4d, 4e, 5b, 5f

Lower Costs: The microgrid will allow the facility to cut operating energy costs, which will make the economics of anaerobic digestion of food waste and biosolids more feasible in the state.

Greater Reliability: The project is located near the end of the San Bernardino Corridor, a congested transmission system, and will provide distributed power resources to this area. Greater electricity reliability will result by implementing demand response, minimizing peak power demand and by providing a local source of 2 MW of power. This will alleviate grid bottlenecking and enhance power supply resiliency and reliability to nearby disadvantaged communities.

Environmental Benefits: The RBF will support diversion of food waste from landfills and enable the state to better utilize biosolids, rather than ship them to neighboring states for management; thus, reducing greenhouse gas emissions.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$486,993

Match Partner and Funding Split:

The Grant Farm, Inc: $80,000 (0.7 %)

Trinity Consultants: $77,360 (0.7 %)

Rialto Bioenergy Facility LLC: $3,256,049 (28.3 %)

Southern Electric: $3,101,591 (26.9 %)

Match Funding:

$6,515,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

54 out of 60 bidders

Rank of Selected Applicant/ Bidder:

Group 2: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the project team finalized purchases of combined heat and power (CHP) units, inverters, and batteries. The team also completed supporting CHP infrastructure including natural gas pipelines, biogas pipelines, and electrical and controls conduit installation. Finally, the team developed the Testing and Commissioning Plan to outline the microgrid system operation and testing procedures.

Project Name: EPC-17-055 - Redwood Coast Airport Microgrid

Recipient/Contractor: Humboldt State University Sponsored Programs Foundation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 8/8/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

As load serving entities, CCAs need to procure utility scale renewable generation and energy storage to serve their customers. IOUs are transitioning to the grid of the future by updating interconnection processes, developing new tariff structures, and grappling with the effects of more intermittent renewable energy on the grid. Meanwhile climate change has increased the frequency and severity of natural disasters, highlighting the importance of keeping critical facilities operating to provide emergency services in times of dire need. The project will demonstrate a replicable business case for critical airport microgrids and potential tariff structure between a CCA and a utility.

Project Description:

This project is a community scale renewable energy microgrid located at the California Redwood Coast Humboldt County Airport. It will demonstrate the first multi-customer, front-of-the-meter microgrid with renewable energy generation owned by a CCA (Redwood Coast Energy Authority or RCEA) and the microgrid circuit owned by an IOU (PG&E). This microgrid will allow the CCA to participate in the CAISO wholesale electricity market and provide low carbon resilience to a commercial airport and U.S. Coast Guard Air Station, which are critical emergency facilities in Humboldt County.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

In order to manage increased DERs, California needs sophisticated DER management systems and strategies, and microgrids can play an important role. This project will lead to significant technological advancements and breakthroughs by designing the microgrid to provide both end-use customer support and wholesale market participation. Furthermore, PG&E will develop engineering standards, testing protocols, and equipment specifications for multi-customer, front-of-the-meter microgrids within their distribution system. RCEA will collaborate with PG&E to create experimental tariffs and agreements for development and operation of the microgrid. These tariffs and agreements will become important examples to other IOUs and CCAs and inform the CPUC's microgrid tariff proceeding.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed) Smart Inverter: D.14-12-035 (in R.11-09-011) Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1a, 1b, 1i, 2a, 3h, 5a

Lower Costs: The solar PV array will lower annual energy purchases by using onsite renewable energy resources to meet a portion of the onsite load; thus, lowering costs.

Greater Reliability: Reliability and resilience will be increased for the commercial airport and US. Coast Guard Air Station (two critical facilities). Due to the remote and isolated location of Humboldt County, these critical facilities will provide the means to transport critical supplies into and around the region in a large-scale emergency. Because of the large PV array and storage battery, the microgrid will be able to supply nearly continuous power in the event of a prolonged outage.

Economic Development: The microgrid, with 3100 MWh/yr of renewable electricity generation coupled with energy storage, is estimated to generate an annual economic benefit of approximately $356,000. During the construction phase, an estimated 37 full time jobs will be created, with $1.5M in earnings and $3.4M in economic output.

Environmental Benefits: Over 3100 MWh/yr of renewable electricity will be generated. This is estimated to result in CO2 emission reductions of over 880 MT/yr.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$500,449

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$220,833

Match Partner and Funding Split:

Redwood Coast Energy Authority: $5,996,358 (53.0 %)

Humboldt State University Sponsored Programs Foundation: $326,370 (2.9 %)

Match Funding:

$6,322,728

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

54 out of 60 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 2

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-17-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project team defined the microgrid system architecture and executed fixed price contracts for the battery energy storage system, solar PV system, and microgrid controls. The microgrid design neared 100% completion. The microgrid construction activities are anticipated to start in early 2020 and end in early 2021. The project team made substantial progress on the microgrid experimental tariff development and will provide input to the CPUC's microgrid tariff proceeding. The project team also participated in the CAISO Hybrid Resource Initiative. This initiative will have an impact on the project because the wholesale generator interconnection to the CAISO grid will be a hybrid resource (DC-coupled PV & battery).

Project Name: EPC-18-001 - Port Hueneme Navy Data Center Microgrid

Recipient/Contractor: Electric Power Research Institute, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 11/1/2018 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S14: Take Microgrids to the Next Level: Maximize the Value to Customers.

Issue:

Microgrids often experience system failures during transition between grid connected and islanding modes due to electric instabilities (e.g., unstable voltage, current, or power waveforms). Many of the controlling systems cannot recognize and respond to these rapid events. This is especially problematic for facilities that are sensitive to instabilities, such as data centers.

Project Description:

This project will demonstrate a standardized, high-penetration distributed energy resource (DER) microgrid to support a data center at the Naval Surface Warfare Center - Port Hueneme Division near Oxnard, CA. The data obtained on capital cost, operating cost, performance and lessons learned will support commercial deployment for both military and non-military applications.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project is developing new approaches to microgrids that can ensure stable power to sensitive components, such as in data centers. The team will demonstrate a standardized microgrid, analyze and define the savings and market barriers, and provide new, valuable performance data that will be used to develop a viable market for future deployments.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart Inverter: D.14-12-035 (in R.11-09-011) Demand Response (DR): R.13-09-011 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1a, 1b, 1e, 1h, 1i, 2a, 5a

Lower Costs: The collective use of installed on-site PV and battery energy storage system (BESS) will significantly reduce the need for the Southern California Edison (SCE) grid supplied energy and, in turn, will decrease the resulting cost of energy to the site. Furthermore, replacing the current leased lead-acid BESS with a permanent Li-ion BESS will save the site on leasing fees.

Greater Reliability: The microgrid will allow the site to operate independently from SCE grid, supply power with lower cost PV renewable energy from a localized source, and nullify the potential detrimental outcomes due to unplanned power outages. The findings from this project will be leveraged to recommend a standardized design to improve reliability and lower capital costs of future microgrids in commercial applications.

Environmental Benefits: The microgrid's combined use of renewable PV generation, battery energy storage, and EV charging stations will reduce carbon emissions, which are produced by fossil fueled power generation and automobiles, and will dramatically reduce the need for fossil fueled backup diesel generators for up to 4-hours during night time and islanding events at the data center.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$848,609

EPIC Funds Encumbered:

$4,998,345

EPIC Funds Spent:

$86,006

Match Partner and Funding Split:

Electric Power Research Institute, Inc.: $1,738,707 (20.5 %)

Schweitzer Engineering Laboratories, Inc.: $1,537,028 (18.1 %)

Distributed Utility Associates: $227,019 (2.7 %)

Match Funding:

$3,502,754

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

54 out of 60 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 6

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

EPRI conducted engineering analysis for the microgrid system design and coordinated these activities with the Naval Base host. The team finalized the microgrid system architecture and signed a fixed price contract with Northern Reliability, Inc. for the battery modules. Factory acceptance testing of the battery modules is expected to be completed in the second quarter of 2020; and the battery modules will be shipped to the Naval Base in the third quarter of 2020 for further testing, commissioning and safety certification prior to installation at the data center project site. EPRI also finalized the electrical diagram of microgrid connections to the SCE on-site transformer which provides power to the database center.

Project Name: EPC-18-002 - California Test Bed Initiative

Recipient/Contractor: California Clean Energy Fund dba CalCEF Ventures

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 12/10/2018 to 3/31/2023

Program Area and Strategic Objective:

Market Facilitation

S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

In California, clean energy entrepreneurs and innovators experience significant difficulty making the leap from prototype to pilot scale demonstration of their technologies because they lack access to testing facilities and services to validate their products' design, safety and performance; and lack technical feedback to shift product specifications to meet the requirements of potential customers.

Project Description:

This project will develop and implement a voucher program to provide clean energy companies access to testing facilities to test and/or certify prototypes of pre-commercial distributed energy resource technologies, and help them refine their prototype to meet customer specifications. This project will start with an initial network of testing facilities that includes 29 University of California facilities from nine campuses and two National Laboratory facilities. The project intends to grow this network throughout the duration of the project. This network of testing facilities will connect testing facilities throughout California, which would otherwise be disconnected, in order to serve clean energy companies more efficiently and effectively throughout all of California.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

CalTestBed will accelerate new, clean, energy-efficient technologies to market and, as a result, reduce ratepayer costs. By early engagement of target customer groups in the refinement of product specifications and the evaluation of commercial viability, CalTestBed will accelerate the rate of development and commercialization of technologies that improve California's air, water and energy profile and drive economic investment, business creation and jobs.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 2a, 3a, 3b, 3e

Increase Safety: CalTestBed develops and streamlines the feedback process among testbeds to meet customer safety specifications, as well as supporting the standardization of "customer-facing" services by testbeds to the innovation community. Through the CalTestBed Network, coordinates California testbeds to standardize safety testing and certifications and develop best practices for managing the testbed/entrepreneur relationship. Includes Customer Engagement elements to involve customer groups in evaluation of the safety of proposed technologies.

Economic Development: CalTestBed will provide objective feedback to help entrepreneurs improve their products to meet customer needs, and grow into self-sustaining businesses. These services that CalTestBed will provide will increase the likelihood that clean energy companies can develop and scale their technologies and bring them to the market.

Consumer Appeal: CalTestBed will provide the opportunity for target customer groups to give feedback to entrepreneurs letting them know what changes can be made to improve their products to meet customer needs.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$566,364

EPIC Funds Encumbered:

$10,999,701

EPIC Funds Spent:

$0

Match Partner and Funding Split:

California Clean Energy Fund dba CalCEF Ventures: $267,053 (2.2 %)

University of California, Office of the President: $620,000 (5.2 %)

Match Funding:

$887,053

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

15 out of 15 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, the recipient focused on developing and finalizing all materials, plans, and processes necessary to launch the CalTestBed voucher program, including test bed directories, solicitation manuals, and user agreements. The project held a launch event in November 2019 at the UC San Diego campus. The project will issue its first solicitation for vouchers in early 2020.

Project Name: EPC-18-003 - Ultra-thin Flexible LED Lighting Panels

Recipient/Contractor: Lucent Optics, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 1/23/2019 to 3/31/2022

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Adoption of lighting emitting diode (LED) lighting for general illumination is poised to be the largest advancement in building lighting efficiency during the 21st century. LED manufacturers have focused on research into improving the efficacy and cost at the expense of quality, resulting in an influx of poor quality LED products with minimal options. This has led to use of the same outdated legacy forms and bulky designs of the incumbent fluorescent fixtures and thus fail to create a unique aesthetic appeal for the end-users. All this dramatically slows down the adoption of LED technology and prevents realizing its full energy saving and technological potential.

Project Description:

The project will produce a custom thin, flexible lighting platform technology for making material-efficient and aesthetically pleasant wide-area LED lighting luminaires at a fraction of the cost of traditional fluorescent and LED fixtures. The objective is to create a universal, area-distributed LED source and associated luminaire technology platform that would (1) set a new standard for wide-area luminaire efficiency, (2) provide much lower cost of ownership compared to other lighting technologies, and (3) dramatically improve aesthetics of lighting fixtures and provide virtually unlimited design opportunities through introducing thin and flexible forms.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project could improve understanding of metrics and test procedures associated with LED quality and performance; increase the ability of commercial building operators/owners to comply with future energy codes and standards; produce higher quality LED products; and, increase consumer acceptance of LED lighting luminaires.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a, 3a, 3b, 4a

Lower Costs: The energy efficient lighting products resulting from this project will lower the electricity bills of California ratepayers by lowering their energy use for indoor lighting, thus providing the benefit of lower energy cost for the electricity ratepayers. By replacing just 60% of the linear fluorescent lights in commercial buildings, the proposed technology could save 5,610 GWh to California IOU electricity ratepayers and reduce their energy costs by $900 million on the annual basis. The annual cost reductions due to energy saving ($900 million) are calculated using the statewide average electricity price of $0.16/kWh in the commercial sector (5,610 GWh x $0.16/kWh).

Greater Reliability: The lighting solution provided in this product gives a longer lifespan than standard LED luminaries of about 75k-100k hours. The reduced consumption of electricity for this lighting solution will reduce peak demand and electric grid loads, thus contributing to the improvement of grid reliability.

Increase Safety: The proposed wide-area LED lighting panels will replace fluorescent lights that have been associated with environmental hazards (due to the mercury content), suboptimal energy efficiency, poor quality of light (choppy spectrum missing warm colors, flickering and glare), subpar aesthetics, and the need of periodic lamp replacements, thus increasing safety in buildings.

Environmental Benefits: The lighting products developed in this project will give an annual reduction in greenhouse gas emissions by using the Emission Factor 0.331 kg/kWh, which yields 1.857 million metric tons (5,610 GWh saving x 0.331 kg/kWh).

Consumer Appeal: The innovative lighting solutions developed in this project are anticipated to improve occupant comfort by providing higher-quality, ambient lighting environment and eliminating glare and environmental hazards of fluorescent lights.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$516,434

EPIC Funds Encumbered:

$1,692,069

EPIC Funds Spent:

$192,732

Match Partner and Funding Split:

IVESTA LLC: $169,207 (9.1 %)

Match Funding:

$169,207

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

21 out of 33 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 5

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-existing and new (to this project) intellectual property for the lighting technology being further developed with this project includes: designs, engineering drawings, materials, and procedures which may give its user an opportunity to obtain a business advantage over competitors who do not know or use it. For a complete list of what shall remain confidential, please see the Exhibit C form.

Update:

In 2019, Lucent Optics has performed electrical and optical testing on the new experimental high-performance LED strips modules for prototyping the wide-area thin, flexible LED lighting panels. From the successful testing result, Lucent Optics will be able to determine the constraints within the design package to create the optimal improvement strategy for the next stage of the prototype. Lucent Optics is also planning to rework the principal structure of the lighting panel to enable large light-emitting areas with minimal light spillage, which will help the technology toward its goal for distributed lighting with high efficiency without glare.

Project Name: EPC-18-004 - Accelerating Commercialization of Advanced Energy Efficient Windows

Recipient/Contractor: Ubiquitous Energy, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 2/8/2019 to 12/12/2022

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Although premium low-E windows maximize the rejection of excessive heat from entering a building, it usually does so at an unwanted aesthetic tradeoff as seen in the windows having an undesired pink-purple color tint. Additionally, the solar heat being reflected back into the environment is not being captured as useful energy. To date, there is not a market ready window product that effectively prevents heat from entering the building through the windows, generates renewable energy, and is easily manufactured at an attractive price point.

Project Description:

This project will scale Ubiquitous Energy's ClearView PowerTM technology to meet the size requirements and specifications needed for window production. ClearView PowerTM is a transparent solar coating that, when applied to glass, selectively absorbs and converts non-visible light to electricity while also blocking the infrared light that causes heat gains in buildings. As part of this project, Ubiquitous Energy will demonstrate that the solar coating application can integrated into a standard glass manufacturing process.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The mass-market commercialization of clear windows that generate renewable energy and premium insulation will provide demonstrable improvements over existing low-E windows currently used in commercial buildings. This will allow California to better design and create zero net energy (ZNE) buildings to meet the state's energy efficiency goals. Furthermore, CVP's solar generating capabilities would broaden the application and generation of solar energy throughout California.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1e, 1f, 2a

Lower Costs: The increased insulation and electric generation will lower the operation costs of commercial buildings in California.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$407,192

EPIC Funds Encumbered:

$2,998,055

EPIC Funds Spent:

$406,015

Match Partner and Funding Split:

Ubiquitous Energy, Inc.: $4,085,059 (55.9 %)

Lawrence Berkeley National Laboratory: $225,600 (3.1 %)

Match Funding:

$4,310,659

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

21 out of 33 bidders

Rank of Selected Applicant/ Bidder:

Group 1: Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kicked off in April 2019 and the team immediately began testing on smaller R&D prototypes both internally for optical performance, and at LBNL for validation measurement. The results were mostly consistent and met performance expectations. LBNL also started modeling and test cases, accounting for electricity generation from heat gains for the first time ever. In October, Ubiquitous Energy held a grand opening marking expansion of their plant in Redwood City for production of their larger sized samples (14" x 20"). Additionally, they installed a 2x3 panel of the larger sized prototype glass panes at their offices in November. Next year the team will continue to test and refine the larger prototype samples to ensure they meet performance and commercialization requirements, engage with window manufacturers, and identify opportunities for possible pilot demonstrations.

Project Name: EPC-18-005 - Building Energy Impact Analysis of Low Cost NanoEC Electrochromic Window Control Algorithm Optimization

Recipient/Contractor: Heliotrope Technologies, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 1/16/2019 to 11/30/2021

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

Lighting and thermal management each represent about 30% of the energy used within a commercial building. Windows are a critical component of building energy efficiency in part because they determine the amount of natural light and solar gain that enters a building. Recent progress has been made toward improving window energy efficiency through the use of inexpensive static coatings that either retain heat in cold climates (low emissivity films) or reject solar heat gain in warm climates. However, these windows coatings are not responsive to changing occupant needs, have limited performance in seasonal climates, and have a high cost of greater than $50/sq. ft.

Project Description:

Heliotrope's NanoEC is the first neutral grey electrochromic window product that achieves a price point less than $25/sq. ft. This project is aiming to evaluate and optimize the building energy impact of this electrochromic smart window. By reaching the color/cost barriers needed to create mass adoption, Heliotrope will use this project to design, test, and validate energy conservation in building applications through field installations at both a test bed facility and at a real world commercial facility. Data from this study will help optimize window tinting control algorithms to achieve the lowest building energy consumption.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by developing a dynamic glass technology that will reduce HVAC energy consumption. By optimizing the control algorithm design in this project, Heliotrope's NanoEC electrochromic smart windows will improve thermal management within buildings. This technology is also showing an increase in light energy savings while providing product improvement of color and overall cost.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1e

Lower Costs: Heliotrope's NanoEC electrochromic windows are estimated to have an average daily lighting energy savings of 10-15% compared to south facing static windows with lowered Venitain blinds. Their product is the first electromic product to reach a price point lower than <$25/sq.ft., which is estimated to allow large market adoption.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$1,182,911

EPIC Funds Encumbered:

$3,667,104

EPIC Funds Spent:

$1,757,696

Match Partner and Funding Split:

Heliotrope Technologies, Inc.: $952,276 (20.6 %)

Match Funding:

$952,276

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

21 out of 33 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

In 2019, Heliotrope Technologies established the varying control factor of voltage and current with the smart panel unit at four different stages of lighting (with extremes being transparent to opaque) to measure the capability of performance on color composition, lighting energy, thermal comfort, and daylight illuminance. These results will contribute to creating controlled electronics for an autonomous dimming window system for standard size smart panel units within commercial buildings. This window system will be able to tint on-demand based on feedback from an automated electronic sensor, achieve the desired tint state based on user preference, and communicate with any adjacent window to ensure that all windows tint at the same rate and level.

Project Name: EPC-18-006 - Radiative Sky Cooling-Enabled Efficiency Improvements on Commercial Cooling Systems

Recipient/Contractor: SkyCool Systems Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 2/21/2019 to 12/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Commercial space cooling and refrigeration systems contribute to a significant percentage of commercial electricity use in California. A challenge with standard cooling systems is that they become less efficient as the ambient air temperature outside rises. This rise in ambient temperature causes the condenser to increase in temperature and pressure, resulting in more energy consumption. The increase in consumption on hot days causes strain to the grid, sometimes resulting in an inability to meet the demand of electricity. There is a need for technologies that reduce electricity use of commercial air conditioning and refrigeration systems that can be added to existing equipment.

Project Description:

This project is demonstrating a technology that will enable new and existing air conditioning and refrigeration systems to run more efficiently and in certain applications replace AC units with a cooling system requiring only the energy to run a pump. The technology being demonstrated is a rooftop-mounted, radiative sky-cooling panel that has a specialized film to enable daytime radiative cooling. The panels cool without evaporating water and only require electricity to run a small circulating pump. The cooling effect from the panels occurs all day, which is well aligned with the 24/7 operation of refrigeration systems in supermarkets and air conditioning systems in data centers and hotels. In this project, SkyCool Panels will demonstrate its use cases at two sites. The first site's panels will pair with thermal storage and an indoor radiant cooling system to demonstrate a reduction of electricity use for air conditioning by as much as 50% relative to conventional cooling systems. The second site's panels will act as a passive subcooler in a commercial supermarket to increase the system efficiency as much as 10%.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals. It will enable the measurement and verification of two promising integrations for a platform cooling technology in operational commercial settings, the results of which might not otherwise have been deployed if pursued purely through a competitive consumer market. SkyCool technology will help California reach policy goals set out in SB 350, AB 32, and AB 758 by reducing barriers for installing the panels in commercial systems and enable the broader adoption across California's cold chain and HVAC sectors.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a, 3a, 4a, 4c

Lower Costs: This project will demonstrate lower operating costs in commercial buildings with the reduction of electricity usage of a commercial air conditioning system by 50% and a commercial refrigeration system by 10%.

Greater Reliability: Deployment of SkyCool panels can improve grid reliability by reducing facility peak demand. The highest demand for electricity is typically during summer afternoons/early evening when the demand for cooling is greatest. This is in part because conventional refrigeration and air conditioning systems are least efficient during these hottest times. SkyCool panels have equal cooling efficiency across ambient temperature ranges.

Environmental Benefits: Deployment of SkyCool panels can reduce greenhouse gas emissions by reducing the electricity consumed from the grid and do not use heat-trapping refrigerants. SkyCool panels also reduce water consumption associated with cooling because the panels cool without evaporating water.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$406,651

EPIC Funds Encumbered:

$1,770,563

EPIC Funds Spent:

$9,238

Match Partner and Funding Split:

SkyCool Systems Inc.: $238,386 (11.6 %)

Electric Power Research Institute, Inc.: $50,000 (2.4 %)

Match Funding:

$288,386

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

21 out of 33 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 6

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The SkyCool team has focused its efforts on streamlining the layout and deployment of panels connected with refrigeration systems in supermarkets, restaurants and convenience stores. Since the start of the project, the team developed a tool to size panel arrays, heat exchangers and pumps based on the cooling capacity of the air conditioning and refrigeration system. Current work has been focused on finalizing the site plans to begin installation of a panel array in a refrigeration system in the first half of 2020.

Project Name: EPC-18-007 - High Efficiency Dynamic Lighting Systems

Recipient/Contractor: Glint Photonics, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 2/18/2019 to 3/31/2021

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

An estimated 41 TWh of electricity is used annually on lighting by California IOU ratepayers, yet the majority of the generated light is wasted. Spaces are typically over-lit in order to achieve required light levels in all areas, all the time. Department of Energy studies indicate that 2x-3x efficiency improvements are possible through improved light utilization, which represents an enormous energy savings potential. Utilization efficiency improvements will have to come from innovation at the luminaire level, not at the LED source level.

Project Description:

The purpose of this project is to develop, smart, high-efficiency lighting products that dynamically target light to wherever is needed. For this project, Glint will develop the intuitive control systems and a luminaire motorization system to meet long term durability targets. Furthermore, Glint will demonstrate a sensor-linked luminaire that tracks room occupants and directs a task light that follows their location. This novel capability in solid-state lighting, will improve not only the efficiency with which light is generated, but also the efficiency with which it is utilized. In addition to reduced operating energy, these lighting products will provide new functionality, enable customer cost savings by reducing the number of installed luminaires needed, and provide improved lighting quality and safety in the lit environment.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This technology can provide substantial energy savings in California's lighting sector, contributing to the state's Senate Bill 350 energy efficiency savings, and Zero Net Energy Buildings goals outlined in the CPUC's Energy Efficiency Strategic Plan. An estimated savings of up to 18.5 TWh, annually, can be realized in California's investor-owned utility service territories, alone.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 3h

Lower Costs: The dynamic lighting technology will offer customers significant savings. Not only do the products reduce the amount of energy needed to properly illuminate an area (e.g., higher efficiency and fewer lighting fixtures needed), they will be offered at a much lower price than the motorized luminaires that are currently available on the market.

Consumer Appeal: Customers will enjoy a variety of benefits, including: better lighting distribution, less time spent on re-aiming lighting (e.g., product displays, event centers, and galleries), and ability to remotely adjust scene-lighting (e.g., typically experienced in theaters).

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$43,764

EPIC Funds Encumbered:

$1,999,990

EPIC Funds Spent:

$830,884

Match Partner and Funding Split:

Glint Photonics, Inc.: $195,064 (8.9 %)

Chaz Teplin: $5,000 (0.2 %)

Match Funding:

$200,064

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

21 out of 33 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The recipient has successfully completed a proof-of-concept hardware test, designed to evaluate the capability for the chosen hardware controller approach. Additionally, Glint has tested an initial mechanical motorization design to over 10,000 cycles without any evidence of degradation and will continue cycle testing on new designs. In the coming months, the recipient will be working to complete the fabrication of their prototype, which will serve as a testbed platform for control system development.

Project Name: EPC-18-008 - Improving Energy Efficiency and Performance of Wastewater Recycling

Recipient/Contractor: MicroBio Engineering, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 3/6/2019 to 3/30/2022

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

California recognizes that there is a need to maximize synergies in the Water-Energy-Food Nexus. Wastewater treatment facilities have been slow to adopt more efficient technologies due to cost effectiveness and reliability of new systems. There is a need for wastewater systems to reduce energy consumption and chemical usage while also recycling nutrients and fuels from wastewater. A key issue is validating that these technologies can incorporate these benefits year round. Current wastewater treatment pond processes are not effective in winter months and are inefficient at algae - biomass harvesting.

Project Description:

This project will advance the RNEW (Recycle Nutrients Energy and Water) process, which will overcome the seasonal limitation of current wastewater treatment pond processes by the selective use of mechanical aeration to optimize wastewater treatment in winter months and incorporating a two-stage process of biomass settling and filtration for algae - biomass harvesting. The products resulting from this process are unrestricted reuse water, and biomass that can be used to generate biofuels and fertilizers. RNEW is suitable for both small and large communities. The RNEW process can be applied to new, or retrofitted to existing, wastewater treatment plants. The technological and scientific knowledge being advanced by this project are the controlled operation of intensive high-rate algal ponds for year-round wastewater treatment. This includes low-cost harvesting of the algal biomass by a combined algal settling and membrane separation for recovery of energy, fertilizers and reclaimed water.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will advance the science and engineering of algae wastewater treatment systems, to enable current and future California wastewater plants to reduce net electricity consumption while improving plant performance and lower overall costs. The RNEW technology has projected 80% lower electricity consumption and 50% lower

annualized capital and operating costs than conventional activated sludge, and meets California's Title 22 recycled water standards, with much lower nutrient effluent concentrations than currently required.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Water-Energy Nexus: R.13-12-011 (closed)

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a, 3a, 3b, 4a

Lower Costs: California IOU ratepayers will benefit from annual electric power savings, lower costs for wastewater treatment, and reduced environmental impacts overall, including from electricity generation. The project plans to demonstrate at least 50% lower capital and operating costs for the RNEW process, compared to conventional technologies.

Economic Development: The projects economic goals are to improve the cost effectiveness of the RNEW system. Improvements for greenfield purification are projected to be $2,600 per 1M Gal. Improvements for the nutrient removal upgrade are projected to be $350 per 1M Gal.

Environmental Benefits: There is an estimated annual greenhouse gas emissions reduction of 46000-48000 mt CO2e/yr by incorporating algae raceways and turbine generators to the water treatment plants.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$548,356

EPIC Funds Encumbered:

$1,550,227

EPIC Funds Spent:

$0

Match Partner and Funding Split:

MicroBio Engineering, Inc.: $160,000 (9.4 %)

Match Funding:

$160,000

Leverage Contributors:

United States Department of Energy : $200,000

Leveraged Funds:

$200,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

21 out of 33 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Overall, the project is on schedule. The recipient has completed the following in preparation for testing and advancing their RNEW technology of recovering nutrients, energy, and water from wastewater sources toward commercialization:

- The initial pilot plant design and site configuration for Test Set 1 (nitrogen conversion improvement testing) was completed and configuration for Test Set 2 (nitrogen treatment optimization testing) was initiated.

- Installation of pilot plant units began in September 2019 for Test Set 2 and the process of procurement for modifications to Test Set 1 was initiated.

In the closing of 2019, and early 2020, the recipient will focus on the following:

- Completing the setup and configuration for Test Set 2.

- Completing the Effluent Selection and Facility Reconfiguration Report.

Project Name: EPC-18-009 - Energy Savings Through Osmotic Concentration for the Food and Beverage Processing Industry

Recipient/Contractor: Porifera, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/1/2019 to 1/30/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings.

Issue:

There is a need for energy-efficient methods to concentrate food and beverage products with high tolerance to processing conditions, that will not degrade product quality. While thermal evaporators are widely used, they are energy intensive and degrade products. Membrane systems have also been used to concentrate dilute food and beverage products, but most of these systems have significant operation limitations caused by fouling of the membrane and pressure limits. These issues have rendered most membrane systems unusable for the majority of food and beverage processing, including concentration of fruits and vegetable juices, and dairy products.

Project Description:

Porifera will demonstrate a commercial-scale system that offers an energy efficient way to create high quality concentrates without using heat or pressure. They will build and install their PFO Concentrator system, using an innovative forward osmosis technology to reduce energy, chemicals, and maintenance required for food and beverage processors. The system will be installed for operations at a watermelon processing plant in California, for the duration of three consecutive processing seasons. The team will generate and analyze various juice samples throughout the season and post-season, and make refinements to the system until a third and final configuration is able to demonstrate production of a sellable concentrate that is superior to current quality levels. Porifera is also partnering with the U.S. Department of Agriculture (USDA) to study and produce freeze-dry products from the concentrates to demonstrate other applications of the system. Measurement and Verification will be performed by the USDA and results will be shared with Energy Commission staff, industry stakeholders, and the demonstration host site.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will help the state achieve its statutory energy goals by demonstrating an innovative technology that can produce juice concentrate and freeze-dried powder

products that meet food safety standards, is cheaper, and more energy efficient than current mainstream thermal evaporator systems.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 3a, 3g, 4a, 4c, 4d, 4e

Lower Costs: The PFO Concentrator has the potential to provide between 50-90 percent cost savings over conventional thermal evaporators by offsetting energy and water use.

Environmental Benefits: The PFO Concentrator will reduce CO2 emissions and will improve groundwater and surface water resources due to increased reuse of water.

Consumer Appeal: Food and beverage products will have improved aromas, flavors, and colors, increasing the variety of natural products available on the market.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$908,606

EPIC Funds Encumbered:

$2,800,687

EPIC Funds Spent:

$685,215

Match Partner and Funding Split:

Porifera, Inc.: $605,073 (17.8 %)

Match Funding:

$605,073

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

21 out of 33 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Porifera has successfully installed their forward osmosis concentrator at their demonstration site hosted by Van Groningen & Sons, a third-generation California watermelon grower and processor. With the close of the watermelon season the team has processed 10,700 kg of fresh juice into 1381 kg of 65 brix juice concentrate. Samples are being shipped out from the host site to potential product developers for feedback on the quality of the concentrate. The team is preparing their season one report where they will identify system improvements for the next season.

Project Name: EPC-18-010 - Energy and Water Savings in Food and Beverage Wastewater Reuse

Recipient/Contractor: Porifera, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 4/1/2019 to 1/30/2023

Program Area and Strategic Objective:

Applied Research and Development

S1: Improve Energy Efficiency Technologies and Strategies in California's Building, Industrial, Agriculture, and Water Sectors.

Issue:

Affordable water reuse is a pain-point for food and beverage manufacturers, especially in water-stressed areas in the state, like southern and central California. Waste disposal costs and water sourcing expenses are increasing. Manufacturers are looking for solutions that will offset these rising costs of water use and treatment through energy efficient and reuse practices.

Project Description:

The goal of this agreement is to develop new capabilities with the Porifera Forward Osmosis (PFO) Recycler so that it can treat high-starch wastewater from food and beverage manufacturing facilities and turn it into clean water for onsite reuse. If successful, this project will open up new market opportunities for the PFO Recycler and provide California's food and beverage manufacturers with a new energy efficient solution to rising water prices and wastewater disposal costs.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

California recognizes the relationship between water use and energy use. California food and beverage processors are large energy and consumers. This project has the potential to produce an energy efficient method for treating water at the source of its production.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Identify Disadvantaged Communities in the San Joaquin Valley and Provide Economically Feasible Options for Affordable Energy: R.15-03-010 Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1f, 1h, 3a, 4c, 4d, 4e

Lower Costs: This technology would provide benefits to the site operator by decreasing costs for water consumption and electricity for pumping, by as much as 40 percent

compared to the current leading technology. Additionally, by using on-site wastewater treatment, costs are avoided through reduced wastewater treatment.

Environmental Benefits: This project will reduce water consumption and imbedded energy use from pumping and wastewater treatment, resulting in more availability of water and reduced carbon emissions.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$480,430

EPIC Funds Encumbered:

$1,777,132

EPIC Funds Spent:

$182,892

Match Partner and Funding Split:

Porifera, Inc.: $195,000 (9.9 %)

Match Funding:

$195,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

21 out of 33 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 4

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Porifera is currently in the development of their initial PFO recycler. The team is working with Frito-Lay to arrange the terms of their initial testing of treating wastewater consisting of high starch content. The team, meanwhile, has been in the lab setting up the system to soon begin analysis on test samples from the site. The system is scheduled for installation and field testing in quarter three of 2020.

Project Name: EPC-18-011 - Lancaster Advanced Energy Community (AEC) Project

Recipient/Contractor: Zero Net Energy Alliance, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan, 2018-2020 Triennial Investment Plan

Project Term: 6/20/2019 to 3/31/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings., 2.4 Incentivize DER Adoption through Innovative Strategies at the Local Level

Issue:

Local governments and cities will play a large part in reaching California's ambitious renewable energy goals. However, as cities move their energy mix to more renewable energy, they face new challenges. 100 percent renewables requires intelligent resource management to help balance the grid. There is a need for new public-private partnerships and business models that enable cost-effective implementation of zero net energy buildings, community-scale storage and storage, and other distributed energy resources. Finally, intensifying climate impacts have underscored the need to increase local resilience to grid outages by accelerating deployment of renewable microgrids.

Project Description:

This project will deploy energy storage and microgrids at sites throughout Lancaster and integrate these DERs into a first-of-its-kind Virtual Power Plant (VPP). The project will demonstrate the power of local renewables, storage, and flexible load to balance the local grid, mitigate the duck curve, and provide valuable new grid services. These shovel-ready projects include two master-metered, ZNE affordable housing developments that island as microgrids. Renewable microgrids will be deployed at three Lancaster city schools, allowing these schools to provide critical services and act as shelters in an emergency. In addition, 3 MWh of energy storage will be deployed at commercial sites throughout Lancaster via the Lancaster Green District program, which will demonstrate an innovative public-private partnership model. All of these resources will be integrated into the Lancaster VPP, which will enable optimized performance of 5 MW of solar PV and 10 MWh of energy storage. The Lancaster VPP will demonstrate how local load-serving entities can help mitigate the problem of solar over-generation and intermittency with economic DER solutions.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will support the development and commercialization of technological advancements and breakthroughs that overcome barriers to the achievement of the State of California's statutory energy goals by demonstrating a virtual power plant that can optimize the value and improve the economic attractiveness of distributed energy resources. In addition, the project will act as a demonstration for promising technical solutions that will lower costs and provide superior operational value, including a side-by-side demonstration of flywheel and lithium-ion storage systems, as well as several deployments of modular microgrids.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Smart grid: R.08-12-009 (closed) Net energy metering: R.14-07-002 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a, 3a, 3b, 3f, 4a, 5a

Lower Costs: These developments will utilize an innovative stationary storage business model that minimizes up-front capital costs through a shared savings model. This project will demonstrate how master-metering new residential subdivisions can reduce interconnection costs and enable easier participation in grid services markets. Also, the residential microgrids will demonstrate flywheel energy storage, which offers enticing cost savings, extended operating life, and superior perforce compared to conventional battery storage.

Greater Reliability: As Lancaster increases its reliance on distributed solar PV as a base load resource, the battery storage deployments and integration with the VPP will increase grid reliability and substantially mitigate reliability issues with PV generation.

Increase Safety: Lancaster is located directly over the San Andreas fault at the end of a long feeder line, which creates exceptional risk of long-term outages in the event of an earthquake, fire, or other emergency. The residential community and resilient school microgrids will have islanding/anti-islanding capabilities to maintain critical community services and act as shelters during emergencies, while preventing back feeding energy onto the grid.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$809,583

EPIC Funds Encumbered:

$4,999,060

EPIC Funds Spent:

$147,003

Match Partner and Funding Split:

City of Lancaster: $5,025,000 (47.1 %)

Gridscape Solutions, Inc.: $239,720 (2.2 %)

Lancaster School District: $330,000 (3.1 %)

Amber Kinetics, Inc.: $75,000 (0.7 %)

Blue Strike Environmental, Inc.: $5,000 (0.0 %)

Match Funding:

$5,674,720

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

9 out of 9 bidders

Rank of Selected Applicant / Bidder:

Group 6: Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project kicked-off in July 2019. For the remainder of the year, the project team focused on completing planning activities including finalizing the residential microgrid model, the VPP integration plan, and the microgrid cost model for both the residential installation sites and the resilient schools network. In 2020 the project team will begin construction of the planned microgrid installations.

Project Name: EPC-18-012 - Production Scale-Up of Low-Cost, Long-Life Flow Battery

Recipient/Contractor: Primus Power Corporation

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/28/2019 to 3/31/2023

Program Area and Strategic Objective:

Market Facilitation

S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses.

Issue:

Grid energy storage needs significant advances in cost reduction in order to make renewable generation safe and reliable at high penetrations. The current manufacturing process for the Recipient's flow battery, the EnergyPod 2 (EnergyPod), is only suitable for prototype quantities. To successfully execute its cost reduction roadmap, demonstrate the first wave of multi-MW deployments, and fulfill the significant demand for its revolutionary energy storage product, the Recipient needs to transition to a mature, higher volume manufacturing process.

Project Description:

This Agreement funds the EnergyPod scale-up from MRL 7 (Manufacturing Readiness Level) to MRL 8. The EnergyPod is a zinc bromide flow battery that offers energy storage with an estimated five hours of continuous output at 25 kW, a useful life of 20 years, no electrode stack replacement and no fire risk.

Li-ion strengths include maturity and price point. Li-ion weaknesses include fire danger and fade of delivered power over time. Flow batteries do not pose fire risks and generally do not fade over time. At scale, well-designed flow batteries should have a significant cost advantage over other technologies, including Li-ion.

The Recipient (Primus) will transition to a mature, high volume manufacturing process using a contract manufacturing strategy that leverages existing high-volume manufacturing equipment and processes. Primus will receive the major subassemblies for the flow battery from contract manufacturing partners and complete the final assembly in its existing facility. Using this new process of outsourced manufacturing; Primus will be able to increase production while lowering costs, which will lead to Primus' ability to offer more cost effective energy storage.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by scaling up production of the Recipient's flow battery with rated power of 25kW and discharge energy of 125 kWh. Primus' technology offers a battery with no membrane, single flow loop and high voltage with low cost chemistry. The Recipient's flow battery differs from traditional flow batteries in that it does not require an ion exchange membrane and it uses a single electrolyte flow loop. These differences provide significant competitive advantages because they require fewer parts and have longer system cycle life, higher power density, higher reliability and reduced safety risks. The Recipient's flow battery units may be interconnected with each other to form larger energy storage systems.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Smart grid: R.08-12-009 (closed)

Applicable Metrics: CPUC Metrics- 1i, 2a, 3a, 3b, 3h, 4a, 5d, 5e

Lower Costs: The EnergyPod 2 will be able to reduce the market price dramatically of grid energy storage, leading to state-wide cost savings on new storage capacity installations and allowing for increased deployment of renewable generation. The most relevant cost saving metric is the reduction in the market price of long duration energy storage as a direct result of scaling-up Primus' manufacturing capacity and of this specific project. Because Primus' technology benefits from a low raw material cost advantage over all other flow and Li Ion competitors in the market, the EnergyPod 2 is expected to become the market leader in low-cost, long-duration storage once it reaches high volume production.

Greater Reliability: The EnergyPod 2 has a lab-tested 20-year lifespan (30,000 cycles) without performance degradation. Compared to other flow batteries, the EnergyPod 2 is more reliable and energy dense.

Increase Safety: In addition to its sustainability, the EnergyPod 2 is comprised of metals that pose much lower safety and environmental risks compared to Li Ion. The EnergyPod 2's electrodes are made with coated titanium, which have a low-toxicity, have geographically diverse mining resources, and do not pose significant health risks. In addition, the EnergyPod 2 has an inherently non-flammable ZnBr system.

Environmental Benefits: If Primus EnergyPods were used to capture annual renewable over-generation, which equates to 130,000 MWh in 2020 (CAISO forecasting), and then discharged to offset the rapid ramping requirements from natural gas capacity to meet evening peak loads, California would avoid emitting 6,610 metric tons of CO2 per year. As wind and solar supply more of the total annual energy demand in CAISO, the expected curtailment and potential emissions savings from storing over-generation grow as well.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$400,000

EPIC Funds Encumbered:

$4,000,000

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Primus Power Corporation: $6,319,321 (61.2 %)

Match Funding:

$6,319,321

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the

recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-existing and new (to this project) intellectual property for the energy storage technology being further developed with this project includes: designs, materials, and procedures which may give its user an opportunity to obtain a business advantage over competitors who do not know or use it. For a complete list of what shall remain confidential, please see Exhibit C, Attachment 1.

Update:

This agreement was executed on August 8, 2019. In fall 2019 and continuing in 2020, the recipient is focusing on preparing their facility for manufacturing their product (EnergyPod 2) at scale, and testing their product and refining its design for manufacturability. This will include buying and installing equipment for manufacturing at scale, followed by performing initial production tests with design refinements, certifying their product's design, and performing pilot production tests to prepare their product for Low Rate Initial Production.

Project Name: EPC-18-013 - The Oakland EcoBlock, Phase II: A Zero Net Energy, Low Water-Use Retrofit Neighborhood

Recipient/Contractor: The Regents of the University of California, Berkeley

Investment Plan: 2015-2017 Triennial Investment Plan, 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 5/30/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S12: Overcome Barriers to Emerging Energy Efficiency and Demand-Side Management Solutions through Demonstrations in New and Existing Buildings., 2.4 Incentivize DER Adoption through Innovative Strategies at the Local Level

Issue:

California policies are driving the transition to a more decentralized electricity system comprised of DERs that can reduce CO2 and improve resiliency. However, there are currently no proven models for how to scale DER in existing neighborhoods.

Project Description:

Leveraging economies of scale, the EcoBlock advances a new model for scaling DER in existing neighborhoods through holistic block-scale retrofitting that combines deep energy efficiency retrofit strategies, integrated distributed energy generation systems, and water conservation and capture systems in a low-to-middle income neighborhood in the City of Oakland. This project is the second Phase of the EPIC Challenge: Accelerating the Deployment of Advanced Energy Communities. This project will implement the master plan developed in Phase I.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

SB 350 sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Deploying customer-side of the meter technologies at scale will help meet this goal, but will require new innovations to how local jurisdictions design, plan, finance, and manage energy upgrades at the community level. This project is deploying sustainable financing structures, clear owner-operator responsibilities, and streamlined planning and permitting processes, which are critical to successfully deploying community-scale energy retrofits throughout the state.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003

Applicable Metrics: CPUC Metrics- 1f, 4a

Lower Costs: By aggregating the required design, permitting, financing, and construction work across a block of homes, the EcoBlock concept reduces transaction costs, overcomes information barriers, and allows access to lower-cost financing mechanisms that are not available to individual building owners. Moreover, aggregating and collectively controlling the electrical load of an entire block allows the cost-effective construction of a microgrid with shared DERs that further lowers capital costs and improves operational efficiency. Overall, thanks to the economies of scale that its collective approach allows, the EcoBlock leads to lower utility bills and other benefits that translate into lower costs.

Greater Reliability: Reduced electricity consumption and peak demand reduction, achieved by the deep energy retrofits, local storage, and the microgrid controller scheme proposed in this project, will avoid reliance on least-reliable generation sources at the margin. In addition, the microgrid's ability to operate independently ("island") of the PG&E grid in case of emergency or natural catastrophe will protect consumers from grid outages, thanks to the robustness its own DC grid reliability.

Increase Safety: Consumers are safer when more appliances can be switched to locally generated power during grid outages. More important, the microgrid's islanding capabilities enable consumers to gain access to critical electrical end uses (like heating, hot water, lighting, and refrigeration) during outages and potential catastrophic events. Finally, the conversion of end-uses to electricity avoids the dangers of natural gas in the home, including fires, explosions, and combustion products in indoor air.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$700,249

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Spie Batignolles: $1,000,000 (11.8 %)

City of Oakland: $1,200,000 (14.1 %)

EMerge Alliance: $100,000 (1.2 %)

ARDA Power Inc.: $220,000 (2.6 %)

Rexel USA, Inc. DBA Platt Electric Supply: $70,000 (0.8 %)

Building and Construction Trades Council of Alameda, AFL-CIO: $50,000 (0.6 %)

Spectrum Energy Development, Inc.: $33,600 (0.4 %)

Stanford University - Civil and Environmental Engineering: $16,000 (0.2 %)

Morgan, Lewis & Bockius LLP: $800,000 (9.4 %)

Siegel & Strain Architects: $2,000 (0.0 %)

Match Funding:

$3,491,600

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

9 out of 9 bidders

Rank of Selected Applicant / Bidder:

Group 5: Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Work on this agreement began October 2019. After conducting outreach and corresponding with residents of the residential block planned for this demonstration, the project team decided to select a new block in Oakland. UC Berkeley has put together technical criteria for selecting a new demonstration site. Eleven neighborhoods in Oakland have applied to be the new Ecoblock site. Once the new site has been selected, the recipient plans to conduct deep energy audits on the residences and use the data to create engineering and design documents. In 2020, the recipient also plans to establish a Community Facilities District which will allow residents to collectively finance the ongoing operational and maintenance costs of the communal energy and water installations.

Project Name: EPC-18-014 - Production Scale-Up of Thermionic Energy Harvesters

Recipient/Contractor: Spark Thermionics, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/29/2024

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

California is relying heavily on solar PV and wind for clean renewable generation. However, these generation technologies cannot meet peak demands and therefore need to be supplemented with energy storage. Such storage can be provided by the combination of concentrated solar power (CSP) and thermal energy storage (TES), which resolves issues such as lifetime and reliability that plague battery storage. However, currently CSP adoption is limited by its cost, which is more expensive than PV despite being comparable in price several years ago.

Project Description:

This agreement is to fund the production scale-up of Spark Thermionics' thermionic energy converter, to low rate production stage. When combined with next-generation CSP, the Recipient's technology can increase the power output by 75-90% relative to today's best CSP plants. This additional power can drive down the cost to 5.6 cents/kWh. Under this agreement, the project team will analyze cost reduction for process development and manufacturing for the core and encapsulation components within the energy harvesters. The project will also validate that the thermionic topping cycle within the energy harvester has adequate heat rejection from CSP that would be necessary for thermal energy storage (TES) to increase the efficiency and power output of a power generating system. With this technology, flexible generation can address the grid-level challenges of solar PV- generated electricity, namely variability, uncertainty, and nonsynchronous generation.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The high-temperature energy harvesting technology will improve the efficiency of concentrated solar power generation, reducing the capital and operating costs associated with power generating systems. The combination of having a technology that can absorb adaptable amounts of heat and then utilize the heat for time-varying electrical consumption will expedite further large-scale integration of renewable resources to

enable California's highly ambitious energy goals. This technology will allow for more integration of renewables for California at a lower cost.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integrated Resource Planning and Long-Term Procurement Proceeding. LTPP (2016) cycle: R.16-02-007: R.16-02-007 Renewables Portfolio Standard Program: R.18-07-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1b, 1e, 1f, 1h, 1i, 2a, 3b, 4a, 5d

Lower Costs: According to calculations for thermionic topping cycles led by NREL, the levelized cost of electricity (LCOE) for next-generation CSP with TES when combined with a thermionic topping cycle can be as low as $0.056 / kWh. This reduction will result in lower costs for electricity ratepayers compared to competing dispatchable generation.

Greater Reliability: California is targeting 60% of retail electricity to come from renewables by 2030. However, a high penetration of intermittent renewables to achieve this target could jeopardize grid reliability. Concentrating Solar Power (CSP) with thermal energy storage (TES) can not only provide renewable generation, but also flexible, stabilizing generation. Thermionic topping cycles will enable lower costs to drive the adoption of low-cost CSP with the added benefit of reliable, dispatch able generation.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$184,914

EPIC Funds Encumbered:

$1,349,933

EPIC Funds Spent:

$20,460

Match Partner and Funding Split:

Spark Thermionics, Inc.: $270,000 (16.7 %)

Match Funding:

$270,000

Leverage Contributors:

Defence Advanced Research Project Agency: $1,500,000

U.S. Department of Energy: $150,000

Leveraged Funds:

$1,650,000

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 2

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-existing and new (to this project) intellectual property for the lighting technology being further developed with this project includes: designs, engineering drawings, materials, and procedures which may give its user an opportunity to obtain a business advantage over competitors who do not know or use it. For a complete list of what shall remain confidential, please see the Exhibit C form.

Update:

In 2019, Spark Thermionics began analyzing the expenses for current prototypes production to begin the improvement of the cost model development. Some vital cost reductions found were in materials for the encapsulation assemblies and process for integrating the core components in the final device. These new findings are estimated to reduce one-third of the standard cost of the energy harvester. Spark Thermionics has also relocated into a larger space which will be able to accommodate in-house production of the energy harvester components. For the next stage of the project, Spark Thermionic will acquire important equipment, such as a leak detector and tube furnace, that will assist in evaluating the quality control of energy harvester components developed from new materials and streamlining the process of integrating all components in the final device.

Project Name: EPC-18-015 - Improved Batteries for California's Zero-Emissions Vehicle Future

Recipient/Contractor: Cuberg, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 12/31/2022

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

The performance of lithium-ion batteries is beginning to plateau as the technology approaches the fundamental limits of the materials. New types of batteries with new chemistries are required to continue to create batteries with more energy capacity, durability, and power. Batteries with lithium metal anodes can hold more energy than traditional Li-ion technologies and some are nonflammable. However, these batteries can be expensive to make and saving manufacturing costs by using low-cost foreign contract manufacturers can compromise the intellectual property.

Project Description:

The purpose of this Agreement is to fund the setup and commissioning of a pilot-scale production facility for manufacturing lithium-metal battery pouch cells. These innovative lithium-metal battery cells have a high energy density and are non-flammable. The Recipient has pioneered a capital-efficient approach to scale up by using low-cost foreign contract manufacturers to produce the parts of the lithium metal battery that are standard and finishing the manufacturing in-house. During in-house manufacturing, dry cells are cut open, injected with a unique electrolyte and vacuum-sealed. The Recipient hopes to avoid more than 95% of the capital expense typically required to scale up a new battery technology to pilot production while still retaining tight control over all IP (contained in the liquid electrolyte formulation and formation cycling protocols, which are all done in-house).

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by enabling low rate initial production of high energy and safe lithium batteries, which increase the safety and range of electric vehicles to increase electric vehicle adoption in California. Currently, California aims to have 5 million zero emission vehicles by 2030. Enabling the scale up in pilot production scale will eventually accelerate the mass market adoption of electric vehicles as cheaper, higher range and safer electric vehicles are produced.

This will assist California to achieve statutory goals as electric vehicles become more economically and functionally more appealing for the customers.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Energy storage: R.15-03-011 (closed)

Applicable Metrics: CPUC Metrics- 4a

Lower Costs: These next generation Lithium-metal batteries perform better than today's typical Lithium-ion battery but are expensive to make because each order is made in a one-off fashion. This project will allow the Recipient to research how to achieve low-rate initial production manufacturing which will allow for a lower total cost of production as the technology scales up.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$229,783

EPIC Funds Encumbered:

$1,566,639

EPIC Funds Spent:

$355,830

Match Partner and Funding Split:

Cuberg: $316,200 (16.8 %)

Match Funding:

$316,200

Leverage Contributors:

United States Department of Energy: $1,049,989

Leveraged Funds:

$1,049,989

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 5

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project started in June 2019 and the project team has begun acquiring the equipment and materials needed to conduct testing on how the internal manufacturing process can keep battery cell quality high while increasing output. In 2020, the project team plans to have completed initial manufacturing runs and verified they are able to produce the same or higher quality battery cells.

Project Name: EPC-18-016 - Production Scale-Up of Advanced Wafer Technology for Drastic Solar Photovoltaics Cost Reduction

Recipient/Contractor: Halo Industries, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/31/2024

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

The silicon solar wafer, which is the base material that the individual solar cells are fabricated from, currently account for 30% to 40% of the cost of a solar module. Solar wafers are currently created using a diamond-coated steel wire that cut through cylindrical silicon ignots using a process that results in up to 50% loss of ingot material as silicon saw dust while also wasting significant amounts of water. Additionally, the wafers can vary in thickness by 10-20 micrometers which further increases waste and lowers quality. New solar wafer production methods with less waste and more precision are needed.

Project Description:

The purpose of this Agreement is to fund the production scale-up and validation of a novel solar photovoltaics wafer manufacturing technology, proven at the full-scale prototype level, to low rate production stage. This technology uses silicon laser processing technology which results in no silicon material loss and nearly five times thinner wafers and five times less variation in thickness. This new process does not require water and reduces the GHG emissions embedded in the wafer manufacturing process by 50% while increasing quality and performance.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This Agreement will scale up and validate a novel solar wafer manufacturing technology to low rate initial production and generate significant long-term benefits in the solar photovoltaics field including: a decrease in costs associated with solar modules, an increase in the efficiency of solar modules, a reduction in the environmental impact of the manufacturing of solar modules and an enabling of next-generation solar cell/module architectures.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 1c, 1h

Lower Costs: This project is anticipated to significantly lower the cost of solar PV technology by eliminating the waste associated with solar wafer manufacturing and increasing the quality and precision of the cut.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$584,267

EPIC Funds Encumbered:

$4,000,000

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Halo Industries: $1,250,000 (23.8 %)

Match Funding:

$1,250,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 2: Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

- Intellectual Property concerning the manufacturing of solar wafers from silicon

Update:

This project started in June 2019 and the project team has begun engineering work on analysis tools that will be used to ensure the quality of the silicon wafers remain high while the manufacturing process is scaled up to low-rate initial production. In 2020, the project team plans to have completed initial manufacturing runs and verified they are able to produce the same or higher quality wafers.

Project Name: EPC-18-017 - Scaling Up Pilot Production of Nanoporous Membranes for Battery Storage Technologies

Recipient/Contractor: Sepion Technologies, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/29/2024

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

Batteries, charged with clean renewable energy, are poised to be the 21st century's zero-carbon solution to fossil fuel combustion, powering everything from electric vehicles to the electric grid. In order remove barriers to large-scale adoption and meet the expected increased demand for EVs, battery life, range and cost must be optimized. Current lithium batteries suffer from degradation over extended use periods, vulnerabilities to thermal runaway, and a dependence on rare-earth metals, such as cobalt, sourced from conflict ridden areas of the planet.

Project Description:

The purpose of this project is to scale-up the production of an advanced battery membrane platform for market facilitation of safe, low-cost, and energy-dense batteries. The proposed approach is to establish optimal processes for each key component of the innovative membrane (polymer, polymer ink, and roll-to-roll coating) to generate quality assurance and quality control metrics that will lead to an in-house low rate initial production of the membrane for batteries. The intent is to establish a steady commercialized platform technology that will create multiple market opportunities in a variety of battery chemistries. The innovative membrane, in addition to improving the cycle life of batteries, enables more energy to be extracted from the same cathodes used under previously abusive conditions, operate at elevated temperatures, and allows use of more abundant materials such as manganese instead of cobalt.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The nanoporous membrane platform opens paths to safely increasing Li-ion battery energy density by 15%, dropping the cost below $100/kWh by enabling inexpensive cathodes based on nickel and manganese, and mitigating battery manufacturers' supply-chain risk centered on cobalt. This technology can be integrated with existing Li-ion battery manufacturing infrastructure to reduce barriers to market entry. Beyond Li-ion batteries, this platform membrane technology is already being leveraged to enable breakthroughs in Li-metal batteries for advanced electric vehicles with greater than 350

mile range and ultra-low-cost flow batteries for long-duration grid storage, multiplying the potential for impact.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed) Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1b, 1c, 1e, 2a, 3a, 3f, 3g, 3h, 4a

Lower Costs: The innovative membrane resulting from this project will allow the elimination of cobalt (the largest cost factor) and the use of cheaper materials to reduce cost of Li-ion batteries that will also offer increased life, reliability and range.

Greater Reliability: The resulting membrane will reduce lifetime costs, increasing durability, and boosting energy density of Li-ion batteries for EVs and grid storage.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$382,307

EPIC Funds Encumbered:

$2,675,793

EPIC Funds Spent:

$121,921

Match Partner and Funding Split:

CAMX Power: $150,000 (2.9 %)

Argonne National Laboratory: $210,000 (4.1 %)

Washington Clean Energy Testbeds: $50,000 (1.0 %)

Ambrosi Donahue Congdon Certified Public Accountant: $10,000 (0.2 %)

Match Funding:

$2,489,417

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 3

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-existing and new (to this project) intellectual property for the lighting technology being further developed with this project includes: designs, engineering drawings, materials, and procedures which may give its user an opportunity to obtain a business advantage over competitors who do not know or use it. For a complete list of what shall remain confidential, please see the Exhibit C form.

Update:

In 2019, Sepion Technologies has tested five different reactor system designs and purification methods to inform the project on the proper equipment needed for the production of polymers, which is a vital component of the membrane that enables the movement of ions through the cell. Sepion has built a small-scale reactor system in-house to be used in determining parameters, which includes weight, size and melting point, for the polymer production system. Once the polymer system is finalized, Sepion will use those results to dissolve the polymer in a carrier solvent to create an ink that can easily be coated into this film membranes.

Project Name: EPC-18-018 - Prototype to Production: Modular Battery Platform Project for California Critical Infrastructure

Recipient/Contractor: Caban Systems, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/31/2024

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

California IOU ratepayers are increasingly vulnerable to power outages due to electrical equipment and infrastructure failures, brownouts, wildfires, earthquakes, severe storms and landslides. This makes it imperative to accelerate the deployment of energy storage solutions for critical communication infrastructure to keep ratepayers safe. IOUs also need modular energy supply systems that can be deployed quickly to communities during extended power outages and after natural disasters. This illuminates the need to scale-up production and deployment of reliable, modular energy storage platforms for life-saving, fossil-fuel-free, backup power for critical infrastructure.

Project Description:

This project will scale-up manufacturing for a dedicated, modular battery platform for critical infrastructure (initially targeting telecommunication towers) and make it possible for the manufacturing to be in California. The high-energy-density battery pack has best-of-class battery management and control software to remotely meter, monitor, and control the units. The battery platform is designed for fire resiliency and will withstand extreme temperatures. In combination with onsite renewable energy, the equipment can bring a cell tower under environmental distress back online. In case of Public Safety Power Shutoffs (PSPS), the platform can power telecommunication systems and critical infrastructure for hours or days, restoring communication immediately after a fire, no matter the damage to the grid infrastructure or power lines. The modular battery platform also can be used as a pop-up energy source to be quickly deployed to disaster areas to restore electricity for lights, water, heating, and cooling.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by accelerating the production of an emerging, best-of-class energy storage technology that will improve public safety, lower costs, and reduce emissions. Ratepayers rely on critical infrastructure for communication to keep them connected during power outages often

related to wildfires and severe weather events. Currently, critical infrastructure, including telecomm base stations, radio signal towers, and cell phone towers rely heavily on fossil fuel-powered generators for back-up power. To maintain communication during outages, there is an immediate need to scale-up production for a clean-energy storage platform that can provide services to critical infrastructure during outages.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Self-Generation Incentive Program: R.12-11-005 Energy storage: R.15-03-011 (closed) Smart grid: R.08-12-009 (closed) Distribution Resources Plans (AB 327): R.14-08-013 Streamlining Interconnection of Distributed Energy Resources and Improvements (Rule 21): R.17-07-007

Applicable Metrics: CPUC Metrics- 1c, 1e, 1h, 1i, 2a, 3b, 3c, 4a, 4b, 5a, 5d, 5e

Lower Costs: The project will lower costs for IOUs, and thus ratepayers, by reducing the need for grid extensions to critical infrastructure in remote locations.

Greater Reliability: The project will scale-up production of a modular battery platform that will increase the reliability of life-saving, critical infrastructure during power outages and peak grid hours.

Increase Safety: The project will help increase safety by providing a modular battery platform that can be used as a pop-up energy source for communities when the grid is offline.

Economic Development: The project expects to create 21 new, direct, living-wage jobs in California through the scale-up of their manufacturing facility.

Environmental Benefits: The project will provide environmental benefits by reducing or eliminating the need for diesel- and gas-powered back-up generators for critical infrastructure.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$1,878,760

EPIC Funds Spent:

$98,544

Match Partner and Funding Split:

Caban Systems, Inc.: $1,396,943 (42.6 %)

Match Funding:

$1,396,943

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 3: Ranked # 4

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-existing and new (to this project) intellectual property for the energy storage technology being further developed with this project includes: designs, materials, and procedures which may give its user an opportunity to obtain a business advantage over competitors who do not know or use it. For a complete list of what shall remain confidential, please see Exhibit C, Attachment 1.

Update:

This agreement was executed on July 30, 2019. In the closing of 2019 and continuing into 2020, the recipient will focus on preparing their facility for manufacturing their product (a dedicated modular battery platform for critical infrastructure) at scale, and testing their product and refining its design for manufacturability. This will include buying and installing equipment for manufacturing at scale, followed by performing initial production tests with design refinements, certifying their product's design, and performing pilot production tests to prepare their product for low rate initial production.

Project Name: EPC-18-019 - Treau: Low-GWP, High-Efficiency Heat Pump and Air Conditioner

Recipient/Contractor: Treau, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/31/2024

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

There are limited solutions for space heating/cooling for multi-family and low-income homes. Building heating and cooling sector is rapidly growing due to an expanding middle class and a warming climate. In the US, heating and cooling in buildings constitutes 15% of all energy use and produces more emissions than the transportation sector. The growing energy demand and CO2 footprint must be reduced by using low-Global Warming Potential refrigerants and replacing methane heating with electric heat pumps. Multi-family and low-income residences are limited to poor-performing window and portable ACs with few efficient and low-carbon options compatible with their buildings, budgets, and needs.

Project Description:

This project's purpose is to scale-up a manufacturing line of quieter, less expensive, and easy-to-install, retrofit window electric heat pumps. The unique design allows unfettered access to the window where the unit is placed. The proposed approach is to build successive prototypes, which will be tested for performance and usability to finalize a product ready for manufacturing scale-up. The project will result in quality assurance and quality control metrics, established relationships with suppliers, and a system design that leads to initial low-rate production of room air conditioners for the residential market. The benefits of the project, as related to the California IOU electricity ratepayers, are lower heating and cooling costs, more comfortable homes, and reduced air pollution. Successful execution of this project will accelerate the reduction of cost and emissions of building heating and cooling goals for existing building at significant scale, especially among users of window air conditioners. Additionally, this technology can provide a high-efficiency all-electric product for achieving California's new residential Zero Net Energy Action Plan.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project would help displace low-efficiency window air conditioners, displace the use of polluting HFC refrigerants, and increase adoption of efficient air conditioners and heat pumps in homes and multi-family units. Additionally, because the Treau system uses a

hermetically, factory-sealed, leak-tested refrigerant circuit, the unit substantially reduces the release of methane emissions compared to expensive mini-split systems. With energy savings up to 70% in heating, the technology can help achieve improved building efficiency goals for existing buildings in California. Additionally, Treau can provide a high-efficiency all-electric product for achieving California's residential Zero Net Energy Action Plan.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015) Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 2a, 3a, 3b, 3c, 4a

Lower Costs: Treau's system provides lower costs due to the development of a high-efficiency and low-cost heat exchanger and removing the high cost of professional installation.

Environmental Benefits: Treau's proposed technology saves 33% of the energy used for cooling and 70% energy used for heating compared to existing technologies. Along with using R290, a natural refrigerant, Treau will significantly reduce the cost and emissions of building heating and cooling. Additionally, R290 is capable of offsetting nearly 2 GtCO of emissions per year.

Consumer Appeal: Drawn from user research studies, Treau systems have a strong customer appeal due to their low-noise, low-profile, low-cost, and ease of installation. This technology will increase home comfort with little to no maintenance.

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$834,152

EPIC Funds Encumbered:

$2,805,907

EPIC Funds Spent:

$67,157

Match Partner and Funding Split:

Treau, Inc.: $1,901,907 (40.4 %)

Match Funding:

$1,901,907

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 3

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Pre-existing and new (to this project) intellectual property for the technology being further developed with this project includes: designs, engineering drawings, materials, and procedures which may give its user an opportunity to obtain a business advantage over competitors who do not know or use it. For a complete list of what shall remain confidential, please see the Exhibit C form.

Update:

Treau has already assembled an Alpha prototype of a room air conditioner and developed a prototype test plan. They built a test chamber to characterize how the unit performs on a both a system and component level. Treau is benchmarking the overall product dimensions, weight, and noise level. They are also designing and sourcing components for a Beta 1 prototype. This prototype will assess the manufacturing and supply chain needs. The results will inform future modifications for testing, component selection, design, and control of future prototypes. A dozen prototypes will be installed in Northern California homes to gather valuable consumer feedback. In 2020, Treau plans to develop and beta-test several hundred pre-launch systems and launch publicly in 2021. The goal is to deliver a manufacturing line capable of producing at least 300 HVAC units annually.

Project Name: EPC-18-020 - Production Scale-Up of High Efficiency Adjustable Lighting Products

Recipient/Contractor: Glint Photonics, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/30/2019 to 3/29/2024

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

An estimated 41 TWh of electricity is used annually on lighting by California IOU ratepayers, yet the majority of the generated light is wasted. Spaces are typically over-lit in order to achieve required light levels in all areas, all the time. Department of Energy studies indicate that 2x-3x efficiency improvements are possible through improved light utilization. Utilization efficiency improvements will have to come from innovation at the luminaire level, not at the LED source level. However, luminaire level innovations in particular are often overlooked in favor of more fundamental materials-based technologies.

Project Description:

Glint Photonics has pioneered revolutionary high-efficiency solid-state lighting products that use proprietary optical designs to provide precise control over light distribution, greatly increasing the amount of light that is delivered to the intended target and reducing unpleasant glare. The production scale-up work will focus on Glint's Hero family of luminaires. The objectives are (1) to refine the product design for production, focusing on improvements to manufacturability, quality, and cost; (2) to develop and qualify manufacturing processes, and build Glint's organizational capability to manage pilot production quality and operations; and (3) establish, qualify, and certify a pilot production line in partnership with a California-based contract manufacturer. At the conclusion of the project, the recipient will be ready to begin low-rate pilot production of Hero products and will have a strong foundation in place for scaling to mass production over time.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This technology can provide up to 10.2 TWh annual energy savings in California IOU territories. This a very significant contributor to the state's Zero Net Energy building goals, as set out in the CPUC's Energy Efficiency Strategic Plan and the Energy Commission's IEPR. The luminaires can also help meet the California Air Resources

Board's Climate Change Scoping Plan target of 32 TWh of reduced energy consumption via energy efficiency improvements.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 1f, 3a, 3b, 4a

Lower Costs: The system lowers costs by saving energy and also by reducing the number of luminaires that need to be installed in a particular space.

Consumer Appeal: Customers will enjoy a variety of benefits, including: better lighting distribution, less time spent on re-aiming lighting (e.g., product displays, event centers, and galleries), and ability to remotely adjust scene-lighting (e.g., typically experienced in theaters).

Assignment to Value Chain:

Demand-side Management

Total Budgeted Project Administrative and Overhead Costs:

$619,177

EPIC Funds Encumbered:

$1,998,922

EPIC Funds Spent:

$494,384

Match Partner and Funding Split:

Glint Photonics, Inc.: $399,831 (16.7 %)

Match Funding:

$399,831

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 2

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

Since the kickoff, much of the work has been centered on development of supply chain partners for various components. This included a trip by two Glint employees to Asia to meet with various suppliers. The recipient has initiated work with an industrial design firm, Whipsaw to optimize the design of the Hero luminaire for manufacturability, quality and cost.

In 2020, the recipient plans to refine the high-efficiency adjustable lighting product design, assembly processes, and supplier relationships required for Glint's lighting technology products to improve manufacturability, ensure quality, achieve certification, and reduce production cost.

Project Name: EPC-18-021 - Production Scale-Up for Next Generation Batteries Using Liquefied Gas Electrolytes

Recipient/Contractor: South 8 Technologies

Investment Plan: 2015-2017 Triennial Investment Plan, 2018-2020 Triennial Investment Plan

Project Term: 6/13/2019 to 3/31/2024

Program Area and Strategic Objective:

Market Facilitation

S18: Foster the Development of the Most Promising Energy Technologies into Successful Businesses., 5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

Today's Lithium-ion (Li-ion) batteries were initially designed for consumer electronics (i.e. laptops, cell phones). With the growing demand for grid scale storage and electric vehicles, to decrease emissions, a new generation of batteries with improved performance are required. Improvements to the energy density, cost, and safety of lithium metal batteries, which have a high potential to replace lithium-ion in some application, have been slow to develop due to limitations in electrolyte chemistries.

Project Description:

South 8 Technologies has developed a liquefied gas electrolyte chemistry with increased performance metrics to traditional Li-ion battery electrolytes. These electrolytes enable lithium metal batteries to be produced having an increased temperature range and nearly twice the specific energy compared to traditional Li-ion batteries. Additionally these lithium metal batteries eliminate the risk of thermal runaway hazards. The purpose of this Agreement is to fund the design and build-out for a Low Rate Initial Production (LRIP) pilot line for the manufacture of liquefied gas electrolyte batteries with lithium metal anodes which have high energy density and increased safety.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This technology is advancing alternatives to Li-ion batteries that increase the safety of energy storage while also increasing the energy density. This technology does this by allowing the use of lithium metal anodes through a liquefied gas electrolyte. The developed battery technology will serve as an ideal flexible solution for both grid storage batteries and electric vehicles.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Smart grid: R.08-12-009 (closed) Demand Response (DR): R.13-09-011

Applicable Metrics: CPUC Metrics- 1i, 2a, 3a, 3b, 3h, 4a, 5d, 5e

Lower Costs: The primary goal of any grid-storage battery is to benefit ratepayers through lower cost and lower carbon emissions by enabling further penetration of renewables and increasing grid efficiency. South 8's LiGas cells will sell at an estimated $100 / kWh in full-rate production which leads to an estimated levelized cost between $75/MWh to $100/MWh with additional savings over the lifetime of the project possible due to reduction in thermal management and insurance underwriting due to increased temperature stability and safety.

Increase Safety: With larger battery systems, safety is of primary importance since systems may be installed near populated or environmentally sensitive areas. South 8's battery has eliminated the risk of thermal runaway hazard that is common with lithium-ion batteries.

Environmental Benefits: The recipient estimates that annual emissions reductions for a 1 MWh grid-battery at 146,000 lbs of CO2. This has a substantial benefit to reducing carbon emissions and pollutants to ratepayers, ability to curb climate change and improve well-being.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$230,205

EPIC Funds Encumbered:

$1,028,059

EPIC Funds Spent:

$202,365

Match Partner and Funding Split:

South 8 Technologies: $466,416 (31.2 %)

Match Funding:

$466,416

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

28 out of 31 bidders

Rank of Selected Applicant/ Bidder:

Group 3: Ranked # 2

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

South 8 currently holds rights to ten granted and pending patents. Pre-existing and new intellectual property for the lighting technology being further developed with this project includes: designs, engineering drawings, materials, and procedures which may give its user an opportunity to obtain a business advantage over competitors who do not know or use it.

Update:

South 8 is currently in the design phase of their scaled-up system. A key area of development is designing the equipment to accurately fill cells with the proprietary electrolyte. Current testing is being done on their gas delivery, injection, and sealing system; the team expects to continue testing componentry until the end of quarter two of 2020.

Project Name: EPC-18-022 - Advanced Energy Storage for Electric Vehicle Charging Support

Recipient/Contractor: Natron Energy, Inc.

Investment Plan: 2015-2017 Triennial Investment Plan

Project Term: 6/28/2019 to 3/30/2022

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market and Improve Grid Reliability.

Issue:

Meeting California's goal of 5 million electric vehicles (EVs) by 2030 and electrifying rideshare will require a dramatic acceleration in the deployment of EV charging infrastructure, particularly workplace and EV Fast Charging (EVFC) stations. A sustainable business model for expanding workplace charging and public EVFCs remains extremely challenging because of high utility demand charges assessed during peak demand periods of electricity use.

Project Description:

For this project, Natron will produce an energy storage system (ESS) based on its new Prussian Blue/Sodium Ion (PB/Na-ion) battery technology, UCSD will perform on-grid performance validation of the ESS, and an existing publicly accessible EVgo EVFC station will be upgraded with a new ESS, inverter, and energy management software (EMS). This project will result in a cost-competitive alternative to Li-ion batteries that offers superior performance for high power / short-duration dispatch and long cycle life applications such as EVFC, frequency regulation, and grid stability during short-term utility and ISO outages. Natron will advance the battery manufacturing and product design of the ESS to Technology Readiness Level 8, enabling prompt commercial sales of PB ESS systems into the EVFC market.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The proposed project will generate greater market competition by creating a superior alternative to Li-ion batteries for the EVFC market, accelerating EVFC station buildouts, and thus supporting progress towards California's GHG (AB 32, Exec. Order B-30-15), energy storage (AB 2514, AB 2868) and vehicle and rideshare electrification (SB 1014) goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Alternative Fueled Vehicles: R.13-11-007 Energy storage: R.15-03-011 (closed)

Applicable Metrics: CPUC Metrics- 2a, 3f, 5b

Greater Reliability: Energy storage paired with EVFC effectively manages local reliability and power quality impacts on the distribution grid, particularly in congested urban areas where EVFC is essential to promote adoption for multi-unit residents, disadvantaged communities and rideshare drivers. Furthermore, it enables reliable VGI services such as load following and load shifting at lower ratepayer costs as compared to utility scale storage, and with grid benefits as high as $1 billion per year in 2030.

Increase Safety: Unlike the incumbent Li-ion, Natron's PB/Na-ion batteries are not subject to fire hazards caused by uncontrolled rises in battery temperatures. Instead, Natron batteries are inherently safe in all scenarios compared to Li-ion cells. Natron batteries can be deployed in dense urban and rural remote environments without fear of fire hazards.

Economic Development: The project will fund permanent expanded manufacturing capacity at Natron's Santa Clara headquarters to produce a commercially available product. Natron will add jobs, produce a product for the EVFC market, and spur further EVFC buildout.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$96,753

EPIC Funds Encumbered:

$2,998,064

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Natron Energy, Inc.: $1,239,515 (29.3 %)

Match Funding:

$1,239,515

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

7 out of 8 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kickoff meeting was held in October 2019. Natron is in the beginning stages of product design for the battery energy storage system.

Project Name: EPC-18-023 - Utility Demonstration of Non-Flammable, Aqueous-Zinc Battery Storage: Innovation Scale-Up to Alleviate T&D Congestion and Mitigate Wildfire Risks

Recipient/Contractor: Eos Energy Storage, LLC

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/30/2022

Program Area and Strategic Objective:

Technology Demonstration and Deployment

2.3 Define and Improve the Customer's Business Proposition of Integrated Distributed Storage

Issue:

To date, California investor-owned utilities have focused almost exclusively on commercially available lithium-ion technologies for energy storage, which carries fundamental risks and challenges including potential higher lifecycle cost, potential fire hazards, and supply chain concerns due to raw materials needed and competition with electric vehicles. There is a need to demonstrate and commercialize other energy storage solutions with non-lithium ion technologies.

Project Description:

This project will demonstrate and deploy an Eos Generation 3 zinc hybrid cathode battery storage system at San Diego Gas and Electric's distribution station in Pala, San Diego County. The project will demonstrate the system, which is being designed to improve power and energy density by more than 25% over the previous Generation 2 system. The demonstration will support commercialization of the storage solution by providing data on system performance and safety that are necessary to create confidence in the market.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will demonstrate the application and benefits of a cost-effective and efficient non-lithium-ion energy storage solution to help with load shifting, reduction in grid congestion, and deployment of renewable energy resources to help the state meet its energy goals.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed)

Applicable Metrics: CPUC Metrics- 2a, 5a, 5d

Greater Reliability: Successful installation and demonstration in partnership with a utility will help provide ratepayers with greater electricity reliability.

Increase Safety: There is no inherent risk in this battery technology for starting fires or fueling the spread of wildfires, thus making it a safer alternative to lithium ion storage systems.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$356,447

EPIC Funds Encumbered:

$2,986,110

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Eos Energy Storage, LLC: $2,850,011 (46.7 %)

First Priority GreenFleet: $172,842 (2.8 %)

TBD - Contractor: $99,999 (1.6 %)

Match Funding:

$3,122,852

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

7 out of 8 bidders

Rank of Selected Applicant / Bidder:

Ranked # 2

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The energy storage system was delivered to San Diego Gas and Electric's Pala facility in December 2019. Installation, commissioning, and testing are now underway.

Project Name: EPC-18-024 - Large-Scale Sulfur Thermal Battery Demonstration for Enhanced Grid Flexibility and Increased Renewable Penetration

Recipient/Contractor: Element 16 Technologies, Inc

Investment Plan: 2015-2017 Triennial Investment Plan, 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/30/2023

Program Area and Strategic Objective:

Technology Demonstration and Deployment

S15: Demonstrate Advanced Energy Storage Interconnection Systems to Lower Costs, Facilitate Market and Improve Grid Reliability., 2.3 Define and Improve the Customer's Business Proposition of Integrated Distributed Storage

Issue:

Stationary electrical energy storage plays many important roles in the electricity system to enhance grid reliability and flexibility, and these are expected to grow as the grid continues to evolve with increased penetration of renewable sources. Pumped hydro-electric storage is by far the largest source of stationary electricity storage capacity on the grid today. However, installation of this technology is limited by geographic location, difficulty to permit new sites and high cost. Electrochemical batteries, especially Li-ion, are recently being researched the most for deployment on the grid, but their high cost limits their viability in large-scale and long duration applications.

Project Description:

Element 16's sulfur thermal battery provides a low-cost solution to store and deliver high quality thermal energy due to its low cost, simple chemical composition, high heat transfer rates, and little to no need for any electrical heat tracing due to its low freezing point (~239 Fahrenheit), which guarantees low parasitic load and low O&M cost. The proposed project demonstrates sulfur thermal energy storage technology for electricity storage and generation, thus establishing new paradigms for increasing stored energy capacity and providing new forms of stationary electricity storage systems. With the potential to drastically reduce the levelized cost of electricity.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The development of this project will enhance grid resiliency, support the transmission and distribution infrastructure, and will provide low-cost, long-duration electric storage capacity to the CA grid. Electrically charging the low-cost sulfur thermal battery gives rise to system flexibility with respect to coupling to different types of energy sources and will drive the expansion of intermittent renewable sources such as wind and solar in

California. The installation of low-cost sulfur thermal battery systems provides a financial benefit in the upcoming carbon market scenarios due to reduced levelized cost of electric storage, enables delivery of electricity at peak price periods, provides long-lasting backup power in the event of power outages during storm, etc., and substantially increases overall customer plant revenue.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed)

Applicable Metrics: CPUC Metrics- 1e, 1f, 3a

Lower Costs: The low-cost sulfur thermal battery technology can reduce peak demand charges and on-peak electricity consumption, and provide energy arbitrage. The modular nature of the sulfur thermal battery allows charge power, discharge power and storage capacity to be scaled independently with the overall net outcome of lowering cost for ratepayers and ensuring they are not paying for excess capacity.

Greater Reliability: The integration of low-cost distributed energy storage can help prevent blackouts, and provide long-lasting backup power during outages. Low-cost distributed energy reduces grid transmission congestion and secures stable electricity supply. This demonstration will pave the way for California industrial facilities to reduce their electricity usage during peak demand times, thus reducing the load placed on the California electrical grid, help with the duck curve, and seasonal over-generation or under-generation of renewables.

Increase Safety: By increasing renewable energy generation, fewer natural gas reservoirs will be required and harmful fossil fuel generation can be reduced. With the ability to provide backup power during a grid outage such as storms, it can support critical functions for hospitals, emergency meeting sites, etc.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$430,000

EPIC Funds Encumbered:

$3,000,000

EPIC Funds Spent:

$178,777

Match Partner and Funding Split:

Brad Alan LLC.: $50,000 (1.4 %)

Element 16 Technologies, Inc: $590,000 (16.2 %)

Match Funding:

$640,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

7 out of 8 bidders

Rank of Selected Applicant / Bidder:

Ranked # 3

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kick-off meeting was held on August 13, 2019. The project team is creating computational models to simulate the performance of the energy storage system for design/cost optimization.

Project Name: EPC-18-025 - Scale-up of Magnetocaloric Materials for High Efficiency Magnetic Refrigeration

Recipient/Contractor: General Engineering & Research, L.L.C.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/31/2024

Program Area and Strategic Objective:

Market Facilitation

5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

Issue:

Magnetic refrigeration is a high efficiency refrigeration technology that uses no hydrofluorocarbons (HFCs) and has the potential to replace traditional vapor compression systems. Magnetic refrigeration has been shown to be up to 50% or more energy efficient compared to VCC technologies, without using environmentally hazardous materials. Magnetic refrigeration utilizes the magnetocaloric effect (MCE), which is the temperature variation of a magnetic material after exposure to a magnetic field. However, the lack of low-cost and widely available magnetocaloric materials is preventing the wider adoption of magnetic refrigeration technology.

Project Description:

General Engineering & Research's (GE&R) has developed MCE compositions that meet both the performance and cost requirements to be compatible with large scale implementation of magnetic refrigeration systems. For this project, GE&R will develop the processing systems to manufacture their MCE materials in forms needed for integration into magnetic refrigeration systems (spheres and thin plates). Equipment with 1kg or larger batch processing will be installed to accommodate 1kg/day low-rate initial production. Production at this scale will allow for end users to develop and test magnetic refrigeration prototypes, and ultimately move these systems into production.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

This project will help facilitate further development and deployment of magnetic refrigeration systems, which offer significant efficiency improvements over traditional vapor compression cooling systems while using no hydrofluorocarbons. Increased use of magnetic refrigeration can lead to lower energy use and GHG emissions.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy Efficiency Strategic Plan update and action plans: EE Strategic Plan docs Energy Efficiency Proceedings: R.13-11-005, R. 12-01-005, R.09-11-014 (closed)

Applicable Metrics: CPUC Metrics- 2a, 3c, 3f, 3h, 4a

Lower Costs: Magnetic refrigeration offers a significant reduction in energy consumption compared to traditional cooling technologies that rely on vapor compression. Additionally, the recipient's MCE materials can be produced at a lower cost than is currently available. Both these factors can contribute to reducing costs.

Environmental Benefits: Magnetic refrigeration is a high efficiency refrigeration technology that uses no hydrofluorocarbons (HFCs) and has the potential to replace traditional vapor compression systems.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$409,462

EPIC Funds Encumbered:

$1,088,188

EPIC Funds Spent:

$115,034

Match Partner and Funding Split:

Pacific Northwest National Laboratory: $150,000 (10.8 %)

General Engineering & Research, L.L.C.: $156,791 (11.2 %)

Match Funding:

$306,791

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

28 out of 31 bidders

Rank of Selected Applicant / Bidder:

Group 1: Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

This project kicked-off in August 2019. For the remainder of the year, the project team acquired the necessary equipment to begin testing of various methodologies for production of the MCE including characterization of compositions of new alloys. The testing is used to determine if phase separation or compositional variation occurs during the production process. In 2020 the project team will move towards finalizing the MCE material composition and move towards higher volume production.

Project Name: EPC-18-026 - Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency

Recipient/Contractor: Spatial Informatics Group, LLC

Investment Plan: 2015-2017 Triennial Investment Plan, 2018-2020 Triennial Investment Plan

Project Term: 6/28/2019 to 3/28/2024

Program Area and Strategic Objective:

Applied Research and Development

S7: Develop Advanced Distribution Modeling Tools for the Future Smart Grid., 7.2 Increase the Resiliency of the Electricity System to Climate Change and Extreme Weather Events

Issue:

Many aspects of wildfires in California have changed in the past several decades, including climate patterns and the development of human infrastructure near wildlands. The impacts of wildfire on the electric grid have resulted in increased costs and reduced safety and reliability. Understanding the risks associated with wildfire remains challenging. Operational wildfire behavior models are empirical and not well suited for predicting extreme fire behavior. Therefore, key stakeholders responsible for managing the grid -- including IOUs and state agencies -- lack tools and information that could improve near-term management and long-term planning decisions.

Project Description:

The project is advancing wildfire science by incorporating the interaction of tree mortality and extreme fire weather into next-generation fire models. The project is developing zero-to-seven-day risk forecasts for the grid with predictive capabilities, with computational efficiency and scalability. To support planning, the team is developing long-term fire projections using a coupled fire-climate-vegetation statistical and dynamical model to integrate the latest climate projections, tree mortality, development in the wildland-urban interface, and adaptation strategies. To integrate the models into electric utility management and planning, the team is facilitating workshops with IOUs. To support the Fifth Climate Assessment, the team is developing a web-based scenario analysis tool to visualize and explore the impacts of climate change and adaptation strategies on the grid.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The project will aid regulators and stakeholders in meeting statutory goals by addressing critical fire science gaps and applying the science to provide advanced forecasting capability. Specifically, the project will: 1) advance the science of measuring, modeling,

and analyzing extreme weather events, tree mortality, and fire spread at scale; 2) advance risk modeling frameworks to include wind extrema, statewide maps of fuel loads, updated parameterizations, and indicators of where risk forecasting may underestimate fire risk due to gaps in science; and 3) advance the integration of science relating to vegetation dynamics, the wildland-urban interface, land-use, climate, and adaptation strategies, by building on existing models and comparing approaches.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Strategies and Guidance for Climate Change Adaptation: R.18-04-019

Applicable Metrics: CPUC Metrics- 3a, 3b, 3c, 4a, 4b, 5a

Lower Costs: The project seeks to improve IOU planning and decision-making related to wildfire risk, improving grid reliability and safety and lowering costs.

Greater Reliability: With the use of more granular, dynamic fire-spread models, mitigation activities can be more targeted and damages associated with fire and outages can be reduced. Examples of mitigation activities include fire-hardening (pole pretreatments, equipment replacements or upgrades) and measures to minimize de-energization impacts (such as investments in distributed energy resources).

Increase Safety: Safety will be improved as IOUs can better plan for maintenance cycles to avoid areas of elevated fire risk, reducing the risk of injury and loss of life.

Assignment to Value Chain:

Distribution

Total Budgeted Project Administrative and Overhead Costs:

$546,431

EPIC Funds Encumbered:

$5,000,000

EPIC Funds Spent:

$70,710

Match Partner and Funding Split:

Reax Engineering Inc.: $242,000 (3.6 %)

University Corporation for Atmospheric Research: $49,557 (0.7 %)

Eagle Rock Analytics: $10,324 (0.2 %)

US Geological Society (USGS): $488,514 (7.3 %)

The Brattle Group: $75,000 (1.1 %)

Missoula Fire Sciences Laboratory: $622,000 (9.3 %)

Pyrologix, LLC: $95,000 (1.4 %)

Spatial Informatics Group, LLC: $73,905 (1.1 %)

Match Funding:

$1,656,600

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

9 out of 9 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-18-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kick-off meeting was in July 2019. The research team began assembling the project Technical Advisory Committee and initiating coordination among the project working groups. The research team also developed a plan for siting, installing, and operating a wind profiler to better understand how observed wind data can be used by utilities to improve short-term (up to 15 hours) and very-short-term (from 0 to 3 hours) extreme wind forecasts and enhance situational awareness during high-wind events.

Project Name: EPC-19-001 - Reflex Flow Battery at Farm ACW

Recipient/Contractor: UniEnergy Technologies

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 9/16/2019 to 6/30/2022

Program Area and Strategic Objective:

Technology Demonstration and Deployment

2.3 Define and Improve the Customer's Business Proposition of Integrated Distributed Storage

Issue:

As California moves toward the 50% RPS goal, the shape of the net load curve throughout the year will change wildly. To achieve 50% renewable using non-dispatchable resources, the grid will be necessarily producing 100% or more renewable during most days of the year. Current technologies being deployed generally have a cycle life of around 1000 cycles, which, if cycled daily would not even last 3 years. There are no bankable technologies, demonstrated in the MW scale that can meet the daily cycling required of a 50% renewable grid for the typical asset lifetime of 20 years.

Project Description:

This project will entail the deployment of an advanced vanadium redox flow battery, and the other elements to create a 1.4 MW/5.6 MWh AC Energy Storage System (ESS) at Farm ACW's farm. The project will prove the scalability, the integration requirements, the reliability and the bankability of UET's newest high-performing battery product, the Reflex. The 1.5 MW, 5.6 MWh system will consist of roughly 195 Reflex modules connected in 15 strings. For Farm ACW, the system will provide peak shaving and increased Critical Peak Pricing (CPP) participation, to help save on their electric bill. In addition, the system will island, to create a microgrid during outages. For SDG&E, the system will provide the voltage support at a remote feeder and solar energy time shifting. By time shifting the solar energy from the peak solar output, to the later peak hours, the system will provide value in excess of what Farm receives.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

The development of this project will enhance grid resiliency, support the transmission and distribution infrastructure, and will provide low-cost, long-duration electric storage capacity to the California grid. The integration of the advanced vanadium flow battery system and the Power Conversion System (PCS) and peak power controller will provide a working solution for the California market and grid. The design and permitting of the storage system will provide customers and developers working in California with credible operational data, credible budgetary data and a credible pro-forma design.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Energy storage: R.15-03-011 (closed)

Applicable Metrics: CPUC Metrics- 1e, 1f, 1h, 4a, 5a, 5d

Lower Costs: The advanced vanadium flow battery system's unlimited cycle life and 20-year calendar life promises much lower total cost of ownership for future energy storage applications that require high cycling.

Increase Safety: The advanced vanadium flow battery system's provides increased safety because the system is non-flammable. This is in sharp contrast to other battery technologies that are highly flammable.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$0

EPIC Funds Encumbered:

$2,969,998

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Farm Acw: $1,910,401 (38.7 %)

UniEnergy Technologies, LLC: $55,455 (1.1 %)

Match Funding:

$1,965,856

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

7 out of 8 bidders

Rank of Selected Applicant / Bidder:

Ranked # 4

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-19-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kick-off was held in October 2019. The project team modified the design of the flow battery system and Underwriter Laboratories began testing the system for certification. However, the project is under a stop-work order due to an issue on funds spent in California.

Project Name: EPC-19-002 - "Smart Greenhouse": Integrated Photovoltaics/Photosynthesis for Energy and Food

Recipient/Contractor: The Regents of the University of California on behalf of the Los Angeles Campus

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 10/1/2019 to 12/31/2023

Program Area and Strategic Objective:

Applied Research and Development

4.1 Advance Emerging Thin-film PV Technologies for High Value Applications

Issue:

California is the most populous state and has a high electricity demand across all economic sectors. Also, California has some of the most ambitious goals for decarbonization of its economy and adoption of renewable energy technologies. Solar photovoltaics (PV) play an important role as a distributed energy resource in the state's transition to a low-carbon, resilient economy. However, rooftop space limitations can impede the distributed deployment of PV on buildings. One promising solution to this challenge is the development of innovative, low-cost transparent PV technologies that can be integrated into additional building surfaces and windows.

Project Description:

This project will improve the understanding of materials science and manufacturing approaches for transparent organic photovoltaic (TOPV) materials with conversion efficiency of 15 percent and average visible light transmittance of 30 percent. Moreover, the manufactured TOPV will be installed in a “smart greenhouse”; and tested to assess their efficiency, transmittance, stability, reliability, and also their effect on plant growth.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State’s Statutory Energy Goals:

Development of innovative transparent photovoltaic technologies that can be integrated in buildings, will help to achieve California's renewable energy generation goal and statewide requirement for all new buildings to have solar photovoltaic installed on the new constructions, even where the rooftop space is constrained.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

Integration of Distributed Energy Resources (IDER): R. 14-10-003 Renewables Portfolio Standard Program: R.18-07-003

Applicable Metrics: CPUC Metrics- 1f, 2a, 3a, 3g, 4a, 4c

Lower Costs: Transparent organic photovoltaic materials that will be manufactured and tested as a part of this project, can be produced from a solution at low temperatures contrary to the production of silicon-based photovoltaic modules that involves high temperature processes. This makes manufacturing costs of transparent photovoltaics potentially much less expensive.

Economic Development: Transparent buildings-integrated photovoltaic products do not require permitting for land use approval and could become a state-of the art technology used in buildings, where the roof top space is limited and in areas with land use restrictions. Overall this technology could contribute to the growth of the PV industry and its workforce in California.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$97,807

EPIC Funds Encumbered:

$600,000

EPIC Funds Spent:

$0

Match Partner and Funding Split:

The Regents of the University of California, Los Angeles: $60,000 (9.1 %)

Match Funding:

$60,000

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants/ Bidders:

5 out of 7 bidders

Rank of Selected Applicant / Bidder:

Ranked # 3

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-19-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The agreement was approved at the September 2019 Business Meeting and is awaiting final approvals from all parties. The project kick-off is planned for early 2020.

Project Name: EPC-19-003 - Processing and Architecture Design to Develop and Demonstrate Stable and Efficient Perovskite + Silicon Tandem Modules

Recipient/Contractor: Tandem PV, Inc.

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 10/11/2019 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

4.1 Advance Emerging Thin-film PV Technologies for High Value Applications

Issue:

California seeks to achieve 100% carbon-free electricity by 2045. A new generation of high-efficiency, low-cost tandem PV technologies can help achieve this goal by lowering costs to build and operate solar generation, facilitating economic combinations of solar and storage, and supporting increased installation of solar in urban environments and on homes. Tandem PV modules combine metal-halide perovskite material and silicon to increase solar panel efficiency and can do so without increasing panel ($/W) cost.

Project Description:

This project will develop scalable processing of perovskite photovoltaic layers through spray deposition and rapid thermal annealing to fabricate and test 6x6 inch perovskite/silicon tandem devices with 25% cell efficiency.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Lower cost and higher power density solar through higher-efficiency and lower cost solar panels.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

California Solar Initiative: R.12-11-005 Integration of Distributed Energy Resources (IDER): R. 14-10-003 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1c, 2a, 3b, 4a, 5a

Lower Costs: Tandem perovskite/silicon PV modules will reduce balance-of-systems costs at all installation scales due to their higher efficiency compared with conventional silicon solar panels.

Economic Development: Development of cost-effective manufacturing methods for tandem solar PV provides an opportunity for California to compete with silicon-based PVs produced outside of the United States and develop solar manufacturing jobs in thin-film PV. Furthermore, an improvement to the cost and expanded use of solar energy is expected to increase jobs downstream, for example in solar panel installation.

Environmental Benefits: Increased affordability of solar energy generation will result in higher solar energy penetration and help reduce emissions of carbon dioxide.

Assignment to Value Chain:

Generation

Total Budgeted Project Administrative and Overhead Costs:

$161,295

EPIC Funds Encumbered:

$999,802

EPIC Funds Spent:

$0

Match Partner and Funding Split:

Tandem PV, Inc.: $999,986 (50.0 %)

Match Funding:

$999,986

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

5 out of 7 bidders

Rank of Selected Applicant / Bidder:

Ranked # 1

If not the highest scoring applicant/bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-19-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The project kicked off in November 2019. During the next quarter, the research team will purchase equipment to set up a pilot manufacturing line at the company's facilities and hire additional technical personnel.

Project Name: EPC-19-004 - High-Efficiency Perovskite Tandem Modules with Resilient Interfaces

Recipient/Contractor: The Regents of the University of California, San Diego

Investment Plan: 2018-2020 Triennial Investment Plan

Project Term: 10/1/2019 to 3/31/2023

Program Area and Strategic Objective:

Applied Research and Development

4.1 Advance Emerging Thin-film PV Technologies for High Value Applications

Issue:

The dominant commercialized silicon (Si) PV technology has plateaued at 18-24% conversion efficiency, and the theoretical limit for any single-absorber solar cell under standard operating conditions (1 sun, 25°C) is approximately 30.5%. While other absorbers, such as perovskites, have attracted significant attention in recent years for offering high quality semiconductor, with lower purity and lower fabrication temperatures than silicon (Si), the price of Si modules has fallen by 45% in the last three years to $0.36 per watt ($/W), leaving minimal margin or market for emerging single-absorber PV technology that can only achieve similar efficiency.

Project Description:

The purpose of this Agreement is to develop robust, high-power perovskite-on-silicon tandem photovoltaic (PV) modules that achieve a power conversion efficiency of greater than 32% using low-cost manufacturing approaches. The perovskite top cell will be deposited on textured silicon cells, increasing energy production by 30% when the sun is near the horizon, reducing the ramp rate necessary for other grid participants, and improving reliability at future high PV penetration that is under statutory mandate.

How the Project Leads to Technological Advancement or Breakthroughs to Overcome Barriers to Achieving the State's Statutory Energy Goals:

Perovskite-on-silicon tandem PV modules seek to achieve a power conversion efficiency of greater than 32% during the project period using low-cost manufacturing approaches that can scale to square meter (m2) products with a projected levelized cost of electricity of $0.031 per kilowatt-hour ($/kWh). These modules will incorporate optimized light-trapping and anti-reflection approaches to collect sunlight at wide angles, increasing energy production in the early morning and late evening to facilitate flattening of the duck curve.

CPUC Proceedings Addressing Issues Related to this EPIC Project:

California Solar Initiative: R.12-11-005 Residential Zero Net Energy Action Plan (2015): Residential ZNE Action Plan (June 2015)

Applicable Metrics: CPUC Metrics- 1f, 2a, 4a

Lower Costs: Quantitative cost estimates using the DOE Solar Energy Technology Office's LCOE analysis framework and their cost numbers for balance-of-system indicate that our innovative perovskite-on-Silicon tandem modules will provide a LCOE 30% lower than line-of-sight projection costs of silicon (Si) PV, resulting in lower costs to ratepayers. The jump from Si to perovskite-on-Si tandem cells presents a strong return on investment, yielding a 50% increase in energy generation for a <10% increase in upfront module costs.

Environmental Benefits: Perovskite-on-Silicon tandem modules could produce 50% higher energy yield per area relative to standard Si PV. If the perovskite-on-Silicon tandem modules technology reaches 50% penetration in the CA rooftop market as rooftop installation becomes automatic under the new Buildings Energy Efficiency Standards, it is expected to offset an additional 38 million metric tons of CO2e per year compared to Si PV installations over the same rooftop area. According to EPA metrics, this is equivalent to taking more than 8 million passenger vehicles off the road.

Assignment to Value Chain:

Grid Operations/Market Design

Total Budgeted Project Administrative and Overhead Costs:

$103,945

EPIC Funds Encumbered:

$993,458

EPIC Funds Spent:

$0

Match Partner and Funding Split:

D2Solar LLC: $100,000 (6.1 %)

The Regents of the University of California, San Diego: $559,295 (33.8 %)

Match Funding:

$659,295

Leverage Contributors:

None

Leveraged Funds:

$0

Funding Method:

Competitive

Funding Mechanism:

Grant

No. of Initial Passing Applicants / Bidders:

5 out of 7 bidders

Rank of Selected Applicant / Bidder:

Ranked # 2

If not the highest scoring applicant / bidder, explain why selected:

Funds were awarded to passing proposals in rank order.

Treatment of Intellectual Property:

Pre-existing intellectual property identified in agreement EPC-19-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.

Update:

The agreement was approved at the September 2019 Business Meeting and is awaiting final approvals from all parties. The project kick-off is planned for early 2020.

			Appendix C: Electric Program Investment Plan Project Status Report																
Invest-ment Program Period	**Program Admin-istrator**	**Project Name**	**Project Type**	**A brief description of the project**	**Date of the award**	**Was this project awarded in the immed-iately prior calendar year?**	**Assignment to Value Chain**	**Encumbered Funding Amount ($)**	**Committed Funding Amount ($)**	**Funds Expended to date: Contract/ Grant Amount ($)**	**Funds Expended to date: In house expend-itures ($) *****	**Funds Expended to date: Total Spent to date ($)**	**Admin-istrative and overhead costs to be incurred for each project**	**Leveraged Funds**	**Partners**	**Match Funding**	**Match Funding Split**	**Funding Mechan-ism**
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	300-15-004 Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions	Applied Research and Development	This project is part of the U.S.-China Clean Energy Research Center for Water-Energy Technologies (CERC-WET), co-funded by the U.S. Department of Energy and the Government of China. This project is one of several EPIC-funded research endeavors addressing sustainable hydropower under a warming climate. The project develops an optimization model to ensure efficient hydropower operations, but this model will differ from existing models by taking into account different climate scenarios and regulatory constraints.	3/9/2016	No	Generation	$650,000	$650,000	$7,623	N/A	$7,623	$114,054	$12,500,000	None	$0	0.0%	Contract-Inter-agency Agree-ment (The Regents of the University of California, Merced)
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	300-15-005 Improving Hydrologic and Energy Demand Forecasts for Hydropower Operations with Climate Change	Applied Research and Development	The main focus of this research project is to develop grid-wide forecasts of inflows and electricity demands based on ground sensors and remotely sensed data, with emphasis on the effects from temperature fluctuations on electricity demands, hydrologic conditions, and grid performance. Furthermore, the project improves the accuracy of an existing near real-time Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) product, originally developed at UC Irvine's Center for Hydrology and Remote Sensing.	3/9/2016	No	Generation	$720,000	$720,000	$482,647	N/A	$482,647	$144,000	$12,500,000	None	$0	0.0%	Contract-Inter-agency Agree-ment (The Regents of the University of California, Irvine)
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-006 Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack Prediction	Applied Research and Development	The purpose of this project is to fund research that reduces the stress on current water infrastructure in California. Research includes: (1) development of high water recovery desalination processes for non-traditional waters, (2) characterizing the potential for non-traditional water use in California, (3) development of recycled water scenarios for electricity generation, and (4) improving the characterization of California's snowpack.	3/9/2016	No	Demand-side Management	$1,130,000	$1,130,000	$395,443	N/A	$395,443	$198,000	$12,500,000	None	$0	0.0%	Contract-Inter-agency Agree-ment (The Regents of the University of California, Los Angeles)

Project Name	Intellectual Property	Identifi-cation of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If compet-itively selected, provide the name of selected bidder	If compet-itively selected, provide the rank of the selected bidder in the selection process	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applic-able Metrics	Update
300-15-004 Optimizing Hydropower Operations While Sustaining Stream Temperatures and Ecosystem Functions	Pre-existing intellectual property identified in agreement 300-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Interagency Agreement	N/A	N/A	N/A	N/A	12/21/2015	Yes; Calif Based Entity	Prior studies of the trade-offs between electricity generation and environmental protection have been based on models that do not take real-world policy constraints such as legal and regulatory limitations into account. Additionally, this research will create models to optimize hydropower generation that account for changes in precipitation and runoff due to a warming climate while sustaining downstream environments. These tools will inform decision-making in the context of trade-offs of electricity generation and environmental protection under both a changing climate and relevant legal and regulatory constraints.	2a, 3a, 3f, 4d, 5c	The researchers have developed a hydropower optimization modeling framework that considers institutional and physical constraints placed on hydropower operations. The modeling framework links energy and hydrologic models as well as permit requirements for hydropower facilities in the Upper San Joaquin, Merced, Tuolumne, and Stanislaus rivers under various climate change scenarios. To identify impacts at a scale relevant to facility operations, the researchers will create and run sequences of shorter climatic periods to replicate extended droughts and various combinations of wet and dry periods. This work is scheduled to be completed by January 2020.
300-15-005 Improving Hydrologic and Energy Demand Forecasts for Hydropower Operations with Climate Change	Pre-existing intellectual property identified in agreement 300-15-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Interagency Agreement	N/A	N/A	N/A	N/A	12/21/2015	Yes; Calif Based Entity	The advancement of tools for hydropower scheduling and prediction will facilitate power exchanges in the electricity markets, reduce unnecessary consumption of non-renewable energy sources, and increase the reliability of energy generation. California will be the study region, helping inform California utilities in the management of hydropower resources.	3f, 5c	The research team is continuing work to develop short-term precipitation forecasting framework for key regions in California with a lead time of up to 6 hours. In addition, the team designed a new framework of deep forecasting neural networks Generative Adversarial Network (GAN) which will allow to forecast cloud-top brightness temperature (CTBT) and facilitate the generation of the spatial-temporal information that can be extrapolated for the future events. Furthermore, the project team is performing sensitivity analysis on the proposed Generalized Model Tree (GMT) framework. Researchers are currently testing multiple GMT algorithm settings for both benchmark data and real-case studies, and in early 2020 will identify the optimal algorithm for simulating rule-based hydrologic systems (such as reservoir release simulation and operating rule reconstruction).
300-15-006 Optimizing Use of Non-traditional Waters, Drought Proofing the Electricity System and Improving Snowpack Prediction	Pre-existing intellectual property identified in agreement 300-15-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Interagency Agreement	N/A	N/A	N/A	N/A	12/21/2015	Yes; Calif Based Entity	Research conducted will develop flexible, integrated approaches to reduce energy use and costs associated with the use of non-traditional waters, and minimize the volume of waste water produced from their treatment. In addition, the contract will provide guidance on the "best-fit" technologies for California based on geographic area, energy resources and water quality available. Additional research will provide reliability benefits include improving water forecasting scenarios pertaining to recycled water for electricity generation and snowpack forecasting for hydropower operations.	1f, 1h, 3a, 4a, 4c, 4d, 5a, 5c	The project is on track. Critical Project Review meetings were conducted during the summer of 2019, with significant progress demonstrated in all research areas. The following are interim updates: a) market characterization study of non-traditional waters: preliminary literature review is complete and the team continues to assess sources of nontraditional waters for a full characterization. b) recycled water scenarios are complete and have been submitted for peer review; c) characterization of snowpack and snowmelt: preliminary results have been provided and are being shared amongst peers; d) the real-time snow-water-equivalent diagnostic models for the hydropower plants have been completed; e) for the desalination task, the team has completed tracking of bench scale membrane performance and continue to evaluate methods to improve membrane performance.

Invest-ment Program Period	Program Admin-istrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immed-iately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date: Contract/ Grant Amount ($)	Funds Expended to date: In house expend-itures ($) *****	Funds Expended to date: Total Spent to date ($)	Admin-istrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechan-ism
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	300-15-007 ** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	Applied Research and Development	The CalSEED Initiative helps develop California's next generation of clean energy entrepreneurs, providing two levels of seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough solutions that will benefit electric ratepayers in Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric service territories.	3/9/2016	No	Demand-side Management	$9,788,043	$9,788,043	$6,822,782	N/A	$6,822,782	$1,563,250	$749,608	California Clean Energy Fund dba CalCEF Ventures; Los Angeles Cleantech Incubator; Elemental Excelerator; The Grant Farm, Inc.; Umberg Zipser; Greenlining Institute	$3,396,223	10.2%	Contract
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-007 ** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	Applied Research and Development	The CalSEED Initiative helps develop California's next generation of clean energy entrepreneurs, providing two levels of seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough solutions that will benefit electric ratepayers in Pacific Gas and Electric, Southern California Edison, and San Diego Gas & Electric service territories.	3/9/2016	No	Demand-side Management	$20,211,957	$20,211,957	$0	N/A	$0	$0	$0	None	$0	0.0%	Contract
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	300-15-008 Research Roadmap for Getting to Zero Net Energy Buildings	Applied Research and Development	Itron worked with Energy Commission staff to develop a gaps analysis that identifies, describes and prioritizes research, development, demonstration, and deployment (RDD&D) gaps that need to be addressed to achieve the state's goals for ZNE buildings in a safe, equitable and cost-beneficial manner. The gaps analysis was developed in consultation with stakeholders and subject matter experts through interviews, written comments, and public workshops.	4/13/2016	No	Demand-side Management	$999,884	$999,884	$982,214	N/A	$982,214	$171,332	$0	None	$0	0.0%	Contract

Project Name	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
300-15-007 ** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	Pre-existing intellectual property identified in agreement 300-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 7 bidders	California Clean Energy Fund dba CalCEF Ventures	Ranked # 1	N/A	N/A	No	CalSEED addresses a critical gap in the early technology development phase where small amounts of funding can have a significant impact in bringing new ratepayer-beneficial innovations to market by providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough clean energy solutions.	2a, 3e	In 2019, grants totaling over $5.5 million have been awarded to 29 entrepreneurs throughout the State for a range of projects including a battery electrode coating technology that is expected to lower the cost of lithium ion batteries by 35% while doubling the battery's life and a portable battery diagnostic system that can be embedded in an EV battery pack management system to continuously monitor battery health while detecting and preventing thermal runaway. In total, 71 entrepreneurs have been awarded $150,000 small grants under CalSEED. Ten Prototype Awards for an additional $450,000 each have been awarded under CalSEED given as follow-on funding to CalSEED entrepreneurs whose technologies have the strongest impact and commercial potential. In total, CalSEED awardees have leveraged their grants to raise an additional $3.59M in follow on funding from public and private sources.
300-15-007 ** California Sustainable Energy Entrepreneurial Development (CalSEED) Initiative - Technical Consulting	Pre-existing intellectual property identified in agreement 300-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 7 bidders	California Clean Energy Fund dba CalCEF Ventures	Ranked # 1	N/A	N/A	No	CalSEED addresses a critical gap in the early technology development phase where small amounts of funding can have a significant impact in bringing new ratepayer-beneficial innovations to market by providing seed funding as well as mentoring, technical consulting, and business development services to support energy entrepreneurs and research teams in their quest to develop breakthrough clean energy solutions.	2a, 3e	In 2019, grants totaling over $5.5 million have been awarded to 29 entrepreneurs throughout the State for a range of projects including a battery electrode coating technology that is expected to lower the cost of lithium ion batteries by 35% while doubling the battery's life and a portable battery diagnostic system that can be embedded in an EV battery pack management system to continuously monitor battery health while detecting and preventing thermal runaway. In total, 71 entrepreneurs have been awarded $150,000 small grants under CalSEED. Ten Prototype Awards for an additional $450,000 each have been awarded under CalSEED given as follow-on funding to CalSEED entrepreneurs whose technologies have the strongest impact and commercial potential. In total, CalSEED awardees have leveraged their grants to raise an additional $3.59M in follow on funding from public and private sources.
300-15-008 Research Roadmap for Getting to Zero Net Energy Buildings	Pre-existing intellectual property identified in agreement 300-15-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 6 bidders	Itron, Inc., dba IBS	Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project analyzed the most critical RDD&D gaps that need to be addressed to achieve California's goals for ZNE buildings for all new construction of residential buildings by 2020 and commercial buildings by 2030. Results of the analyses will be used to strategically target future EPIC investments in a manner that provides optimal benefits to IOU electric ratepayers, and maximizes the use of public research and development investments.	3e	This project was completed in May 2018. As a result of this contract, Energy Commission staff have over 60 technology briefs for high potential technologies that require more research. The technology briefs identify research gaps as well as the cost and performance targets needed for broad adoption. This contract also produced a prioritization tool that dynamically sorts the technologies based on weights assigned to priorities such as electrification, impact to the grid, and technology readiness level. The final report is being prepared for publishing on the Commission website.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	300-15-009 ** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	Market Facilitation	This contract will provide market analysis that will address the barriers that hamper commercial development of emerging energy technologies. Tasks under this work authorization contract could include tracking past and current award EPIC technology solutions to monitor successes, more accurately consider future EPIC funding opportunities, inform technology gap analyses, and develop online resources. The deliverables from this project will help prioritize future Energy Commission funding towards technologies that solve the addressed issues.	4/13/2016	No	Demand-side Management	$6,825,763	$6,825,763	$2,517,909	N/A	$2,517,909	$2,714,986	$0	None	$0	0.0%	Contract
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-009 ** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	Market Facilitation	This contract will provide market analysis that will address the barriers that hamper commercial development of emerging energy technologies. Tasks under this work authorization contract could include tracking past and current award EPIC technology solutions to monitor successes, more accurately consider future EPIC funding opportunities, inform technology gap analyses, and develop online resources. The deliverables from this project will help prioritize future Energy Commission funding towards technologies that solve the addressed issues.	4/13/2016	No	Demand-side Management	$112,126	$112,126	$0	N/A	$0	$0	$0	None	$0	0.0%	Contract
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	300-15-010 Research Roadmap for Advancing Technologies in California's Industrial, Agricultural, and Water Sectors	Applied Research and Development	Energetics Incorporated developed a technical assessment and gaps analysis to identify the research needs for advancing technologies in the IAW sectors. They collected information from literature searches and feedback from stakeholders and subject matter experts to identify critical needs and currently available emerging technologies. Together with Energy Commission staff, the team prioritized the technologies for key research, development, demonstration, and deployment areas. Finally, they incorporated the recommendations into a research roadmap that will help inform future EPIC investments for the IAW sectors.	5/17/2016	No	Demand-side Management	$647,728	$647,728	$607,470	N/A	$607,470	$122,646	$0	TSS Consultants; Energetics Incorporated; Taylor Biomass Energy, LLC; Renewable Oil International LLC	$29,610	4.4%	Contract

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300-15-009 ** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	Pre-existing intellectual property identified in agreement 300-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 4 bidders	Navigant Consulting, Inc.	Ranked # 1	N/A	N/A	No	This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Recommendations resulting from this agreement will help the Energy Commission better direct EPIC Program technologies towards addressing customer needs and becoming widespread, commercially available products.	2a, 3e	The project team has nineteen work authorization projects that are either active, in development, or have been completed. These work authorizations assist Energy Commission staff to appropriately target investments in microgrids, energy efficiency technologies, low-income/disadvantaged community research, and other topics. Additionally, a currently active work authorization has launched an online platform that facilitates tailored connections between investors, entrepreneurs, customer adopters and field test sites, and mentors and community based organizations. Over 400 members have joined the platform in the first two months since launch and they have been able to network with each other to form stronger proposal teams for Energy Commission and non-Energy Commission funding opportunities.
300-15-009 ** Connecting Emerging Energy Technologies and Strategies to Market Needs and Opportunities	Pre-existing intellectual property identified in agreement 300-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 4 bidders	Navigant Consulting, Inc.	Ranked # 1	N/A	N/A	No	This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Recommendations resulting from this agreement will help the Energy Commission better direct EPIC Program technologies towards addressing customer needs and becoming widespread, commercially available products.	2a, 3e	The project team has nineteen work authorization projects that are either active, in development, or have been completed. These work authorizations assist Energy Commission staff to appropriately target investments in microgrids, energy efficiency technologies, low-income/disadvantaged community research, and other topics. Additionally, a currently active work authorization has launched an online platform that facilitates tailored connections between investors, entrepreneurs, customer adopters and field test sites, and mentors and community based organizations. Over 400 members have joined the platform in the first two months since launch and they have been able to network with each other to form stronger proposal teams for Energy Commission and non-Energy Commission funding opportunities.
300-15-010 Research Roadmap for Advancing Technologies in California's Industrial, Agricultural, and Water Sectors	Pre-existing intellectual property identified in agreement 300-15-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 4 bidders	Energetics Incorporated	Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project analyzed the most critical R&D gaps in the industrial, agricultural, water and bioenergy sectors that need to be addressed to achieve California's goals for doubling energy efficiency by 2030. Results of the analyses will be used to strategically target future EPIC investments in a manner that provides optimal benefits to IOU electric ratepayers, and maximizes the use of public research and development investments.	2a, 3e	The project ended in May 2018. Energetics conducted additional surveys and webinars to get stakeholder input on high-impact emerging technologies, the barriers to market entry for these technologies, as well as actions that can support market entry, and the success indicators. Feedback from 249 surveys and 19 webinars was analyzed and incorporated into a final research roadmap. The roadmap identifies critical technology gaps, possible solutions, and analysis for six major technology areas: industrial processing, industrial facilities, industrial power, agriculture, bioenergy, and water and wastewater. Energetics recommended a total of 123 energy-saving technologies that were prioritized for the six technology areas. Of these recommendations, 42 technologies are still in the RD&D stage. The roadmap will help inform the Energy Commission's future EPIC investments for the IAW sectors.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	300-15-011 California Commercial End-Use Survey	Market Facilitation	The Energy Commission conducted a CEUS in 2006, since then the energy landscape in California has changed dramatically including the deployment of advanced energy efficiency and renewable generation technologies. This project is updating the CEUS while adding additional granularity by (1) developing a methodology to conduct a survey of the characteristics of commercial utility customers that will serve as a baseline and support the Energy Commission's work on the demand forecast, (2) implementing the survey, and (3) providing an unbiased, comprehensive analysis of the data. When completed, the CEUS will provide a clearer picture of commercial energy end-use which will allow better strategic targeting of policies and incentives which will help facilitate the commercial success and market adoption of technologies, strategies, and other innovations.	5/17/2016	No	Demand-side Management	$7,990,063	$7,990,063	$4,686,891	N/A	$4,686,891	$3,426,324	$0	ADM Associates, Inc.	$100,893	1.2%	Contract
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-15-013 California Investor-Owned Utility Electricity Load Shapes	Market Facilitation	This project will develop analysis to characterize existing and future electricity load in the service territories of Pacific Gas & Electric Company, Southern California Edison Company, and San Diego Gas & Electric Company that will inform the Energy Commission's demand forecast. This information will, by including a mix of emerging energy trends and demand-side innovations, be used to identify and target opportunities to further reduce cost, improve safety, and improve reliability through clean energy technology research, development, deployment, and market facilitation opportunities.	6/14/2016	No	Grid Operations/ Market Design	$1,147,406	$1,147,406	$1,127,082	N/A	$1,127,082	$430,673	$0	ADM Associates, Inc.	$58,330	4.8%	Contract
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-17-003 Distributed Energy Resources (DER) Roadmap	Market Facilitation	This project develops, in consultation with stakeholders and subject matter experts, a research roadmap that identifies, describes, and prioritizes key RDD&D needs to enable high penetration of distributed energy resources (DERs). The roadmap will assess the current status of DERs in California; assess current research efforts, including those at the state and federal level; identify performance and cost targets and research needs; estimate rates for technology performance improvement, cost reduction, and adoption; develop a methodology for prioritizing research needs in the near-, mid-, and long-term; apply the methodology to research gaps to prioritize near, mid-, and long-term research needs; and identify critical cost and performance indicators of success and methodology to estimate research benefits. Finally, the roadmap will identify the type and amount of data needed to advance DER policy and availability of DER financing, particularly for low-income customers; conduct public workshops; and document the roadmapping process.	5/9/2018	No	Demand-side Management	$499,065	$499,065	$261,845	N/A	$261,845	$242,382	$0	None	$0	0.0%	Contract

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300-15-011 California Commercial End-Use Survey	Pre-existing intellectual property identified in agreement 300-15-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	ADM Associates, Inc.	Ranked # 1	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity	The CEUS will provide a more disaggregated sampling of the state's end-uses in the commercial sector, than was historically collected. This level of granularity will lead to more accurate energy forecasts which can assist in keeping rates low as forecasts are used to determine infrastructure needs in long term procurement planning by the CPUC. Furthermore, the data can assist the state in achieving the energy efficiency reduction goals outlined in Senate Bill 350 by supporting the identification and accurate characterization of opportunities for demand-side management, energy efficiency program planning, load shifting, and demand response.	1c, 2a, 5c	In 2019, ADM continued data collection throughout the state. By the end of the year, more than 17,000 sites had been surveyed, of which approximately 15,400 were in IOU electric service territories. During this time, ADM continuously worked to refine the quality control procedures to minimize issues with the data collection process. This included developing new automated procedures for field surveyors to identify incorrect values in the data, and updating the Research Plan to reflect the changes in protocol. The team will work to finalize data collection in the IOU electric service territories, and submit the EPIC final report, by March 2020.
300-15-013 California Investor-Owned Utility Electricity Load Shapes	Pre-existing intellectual property identified in agreement 300-15-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 5 bidders	ADM Associates, Inc.	Ranked # 1	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity	DER technology has advanced significantly over the past decade and current loadshapes used to inform the Energy Commission's demand forecast do not account for the current and future deployment of demand-side innovations. Developing improved loadshapes will provide an accurate assessment of the contributions of clean energy technologies to reducing peak demand, integrating renewable energy, and maintaining electricity system reliability as the deployment of clean energy technologies and strategies increases over time. This information will be used to improve the Energy Commission's demand forecast and analysis, and identify and target opportunities for future EPIC research funding to further reduce cost, improve safety, and improve reliability.	1c, 5c	This project concluded in 2018. The Recipient developed updated baseline end-use load profiles and well as new load profiles characterizing electric vehicle use, photovoltaic use, and additional achievable energy efficiency. The Recipient also developed an updated version of the Hourly Electric Load Model. The Energy Commission's Energy Assessments Division will use this information to develop an annual peak forecast for the California Energy Demand (CED) forecasts, develop monthly peak forecasts for resource adequacy and CED forecasts, develop hourly forecasts to support peak shift analysis for annual peak forecasts, analyze various impacts, including AAEE and electric vehicles, to measure their impact on load shapes, and to provide end-user and other load shapes to outside stakeholders and other analysts.
300-17-003 Distributed Energy Resources (DER) Roadmap	Pre-existing intellectual property identified in agreement 300-17-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 5 bidders	Navigant Consulting, Inc.	Ranked # 1	N/A	N/A	No	This project will inform the strategic and effective targeting of future EPIC investments to maximize the use of public research and development investments. The resulting roadmap will identify and prioritize research on the most critical RDD&D technology gaps to enable transformation of the grid to increasingly integrate DERs. The results of the analysis will provide further detail in the integration into utility planning and operational policies that are critical to the technological improvements and physical connections to the grid.	2a	Navigant completed the DER Technical Assessment in April 2019. Three public workshops were held on March 25, July 25, and September 17, 2019. The first workshop provided information on the publicly released DER Draft Technical Assessment and solicited feedback from stakeholders on the status of DER technologies and strategies today and the barriers currently limiting DERs. The second workshop introduced a prioritization methodology to rank potential DER research needs and also solicited input from stakeholders to better characterize the status of DER technologies and strategies, and to identify barriers to efficient integration. The third workshop summarized the research ideas submitted, discussed the screening process, and presented the preliminary scores and ranks of the research ideas.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-17-004 Measuring Innovation Progress to Guide Future Investment: Evaluation of EPIC Benefits Methodology	Market Facilitation	This project will provide guidance and independent analysis to develop a robust, standardized methodology to evaluate the electric ratepayer benefits attributable to EPIC-funded projects based on best-in-class methods, data, and analytical tools. This methodology will help the Energy Commission better understand how well the EPIC program is meeting its goals and removing barriers to further implementation of advanced technologies to meet the state's energy and climate policy goals.	5/9/2018	No	Demand-side Management	$3,000,000	$3,000,000	$1,646,302	N/A	$1,646,302	$1,716,826	$0	None	$0	0.0%	Contract
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-17-005 Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation	Market Facilitation	This project aims to develop a research roadmap to strategically frame research priorities, potential partnerships, and critical technology milestones to support EPIC portfolio decisions and accelerate progress toward more cost-competitive, flexible and reliable renewable energy generation, operation, and storage.	5/9/2018	No	Generation	$338,059	$338,059	$167,195	N/A	$167,195	$86,365	$0	None	$0	0.0%	Contract
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	300-18-001 Technology Transfer for EPIC Research Projects	Market Facilitation	The purpose of this Agreement is to fund technology transfer services to ensure that the results of EPIC-funded projects are effectively disseminated and communicated to stakeholders. The contractors will work closely with Energy Commission staff to: 1) develop and implement a digital technology transfer strategy for EPIC, including redesigning and increasing the functionality of the Energy Commission-owned Energy Innovation Showcase website to improve its effectiveness and usefulness as a technology transfer tool; 2) conduct up to nine topical forums across the state, discussing key issues affecting the electricity sector; and 3) plan, produce, and manage two EPIC Symposium events.	4/10/2019	Yes	Grid Operations/ Market Design	$3,788,265	$3,788,265	$19,738	N/A	$19,738	$881,903	$0	Gladstein, Neandross & Associates LLC; Larta Institute; Sensis Agency	$1,310,568	25.7%	Contract

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300-17-004 Measuring Innovation Progress to Guide Future Investment: Evaluation of EPIC Benefits Methodology	Pre-existing intellectual property identified in agreement 300-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	3 out of 3 bidders	Industrial Economics, Incorporated	Ranked # 1	N/A	N/A	No	This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the state's statutory energy goals by standardizing the assessment of benefits to ratepayers of EPIC-funded projects.	3e	This project has completed a characterization of the EPIC program portfolio and provided recommended methods for evaluating EPIC's benefits to ratepayers. The project team is currently working with EPIC research area leads to develop research-area specific benefits methodology. The project team is developing tools on a rolling basis when approved by EPIC staff. EPIC staff are starting to receive and pilot test draft methodologies and tools.
300-17-005 Research Roadmap for Cost and Technology Breakthroughs for Renewable Energy Generation	Pre-existing intellectual property identified in agreement 300-17-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	Energetics Incorporated	Ranked # 1	N/A	N/A	No	This Research Roadmap aims to strategically frame research priorities, potential partnerships, and critical technology milestones to help inform EPIC research development, demonstration, and deployment (RDD&D) portfolio decisions and accelerate progress toward more cost competitive, flexible and reliable renewable energy generation, operation, and storage. A roadmap is an effective tool for laying out RDD&D pathways. A robust roadmap considers a spectrum of technology complexity, the current state of the art, rapid expansion of scientific knowledge, competition for RDD&D funding, dynamic customer expectations, and the cost and risk of research.	2a	The team conducted interviews and webinars with experts to prepare a preliminary draft for public discussion. The public discussion was conducted as a webinar to request public comments on the research and development opportunities identified for the research roadmap on renewable energy generation technologies for utility-scale applications. The team collected over 75 comments and developed a Yes/No process for prioritizing comments received from Public Webinar. Subject matter experts engaged to contribute to the Yes/No process and helped determine which initiatives would change from the preliminary draft discussed on the webinar. The project team started drafting the roadmap which will be presented at a public webinar at the beginning of 2020.
300-18-001 Technology Transfer for EPIC Research Projects	Pre-existing intellectual property identified in agreement 300-18-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 6 bidders	Gladstein, Neandross & Associates LLC	Ranked # 1	N/A	N/A	Yes; Small Business, Calif Based Entity	This Agreement will lead to increased benefits for EPIC ratepayers by accelerating the development and deployment of new emerging clean energy technologies.	2a	Kicking off in August, the team immediately began work, setting up a shared project management website and holding weekly calls with staff. The team formed two groups to conduct work in parallel for 1) event planning for the 2020 EPIC Symposium and technical forums, and 2) the new project website. For most of 2019, they worked with staff to draft topics and agendas for technical forums, as well as plan all aspects for the 2020 symposium. Branding and themes for event marketing collateral was also developed. After conducting extensive customer discovery and learning about the state's IT requirements, the team submitted a digital technical transfer strategy for approval, which helped inform the development of wire frames for the project website. In 2020, the team will hold at least three technical forums, a two-day symposium planned for April, and complete development of the website.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-001 Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart	Applied Research and Development	This project aimed to reduce the operational uncertainty in both PV and net load forecasts by producing high accuracy forecasts and linking them to net load forecasts at finer time intervals. This increased accuracy in estimation and incorporation within net load forecasts will enable better integration of intermittent PV generation in California and lead to substantial savings in the associated wholesale energy market costs. The results of this agreement contribute to reduced operational uncertainty behind the Duck Chart by producing high accuracy solar generation forecasts for utilities and the CAISO, and linking these generation forecasts to methods for forecasting net loads at higher temporal resolution. This increased fidelity and connection to net load forecasts will provide critical insights to better manage the rapidly evolving grid in California.	12/10/2014	No	Generation	$998,926	$998,926	$925,538	N/A	$925,538	$268,243	$0	Clean Power Research; Itron, Inc., dba IBS	$453,462	31.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-002 Investigating Flexible Generation Capabilities at the Geysers	Applied Research and Development	This project seeks to expand flexible generation capabilities of The Geysers geothermal facilities and support electrical grid reliability. The current operational configuration of The Geysers were thoroughly evaluated through modeling and field testing to determine ways to expand flexible generation capabilities. Steam field and power plant equipment were modified and tested in various load cycling scenarios to determine operating capabilities and limitations of equipment to achieve flexible generation while avoiding or minimizing any potential damage to facilities. The project team concluded that individual Geysers power plants can operate in a flexible or cyclic operating mode down to their existing minimum generating operating limits. However, when multiple power plants are in cyclic operating mode at the same time, operators were challenged by the required monitoring and related manual adjustments.	12/10/2014	No	Generation	$3,000,000	$3,000,000	$2,822,000	N/A	$2,822,000	$0	$0	Geysers Power Company, LLC; Multiple Equipment Suppliers; Multiple Mechanical Subcontractors; Reservoir Engineering Contractor	$4,362,373	59.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-003 Low- Cost Thermal Energy Storage for Dispatchable CSP	Applied Research and Development	The purpose of this project was the development and demonstration of a robust, low-cost thermal energy storage (TES) fluid -- elemental sulfur. Use of sulfur as a TES fluid will enable overall low system costs, long lifetime, and scalability for a wide range of concentrating solar power (CSP) applications and temperatures.	12/10/2014	No	Generation	$1,497,024	$1,497,024	$1,205,642	N/A	$1,205,642	$198,528	$0	Southern California Gas Company	$300,000	16.7%	Grant

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EPC-14-001 Improving Solar & Load Forecasts: Reducing the Operational Uncertainty Behind the Duck Chart	Pre-existing intellectual property identified in agreement EPC-14-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Itron, Inc., dba IBS	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The project showed that improvements in solar and net load forecasting methods can provide positive financial impacts in the scheduling and procurement of electricity in the wholesale electric market within the State. The results of this research have shown that, just in the period covered by this analysis, the potential savings to all stakeholders would have been on the order of $9 million. With further growth in solar and improvements in integrating behind the meter solar into the California ISO net load forecasts, the team anticipates it can achieve even greater cost reductions. This research sets the groundwork for further research on developing a framework to optimize the use of alternative forecasts by the California ISO into its net load forecast. It may be possible to develop a framework for choosing when to use the alternative forecast to optimize its value to all stakeholders.	1c, 4a, 5c	The project incorporated several forecast improvements by advancing methods for determining BTM system specifications and shading based on measured production inputs, integrating irradiance measurements to improve aerosol optical depth and cloud albedo aspects, and by incorporating near real-time metered PV generation data to fine-tune fleet forecasts of both grid-connected and BTM PV solar. Researchers evaluated three alternative model approaches for extending the CAISO load forecast framework and present the alternative load forecast frameworks for incorporating BTM solar PV forecasts. The study showed that improvements in solar and net load forecasting can provide positive financial impacts in the scheduling and procurement of electricity in the wholesale electric market within the State. The potential savings would have been on the order of $9 million just in the covered period.
EPC-14-002 Investigating Flexible Generation Capabilities at the Geysers	Pre-existing intellectual property identified in agreement EPC-14-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Geysers Power Company, LLC	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The technical and economic benefits of this study will come from expanding the flexible generation capabilities of The Geysers generation facilities to maintain grid reliability and help support additional variable renewables to meet the state's RPS goals.	2a, 4a, 5a, 5b	The project conducted a study to investigate flexible electrical generation capabilities at The Geysers. The modeling work performed in this project resulted in successful development and application of a simulation-optimization framework for the optimal control of the steam field under load curtailment. Upgrades installed during this study removed turbine related constraints, made it feasible to achieve rapid cutbacks using existing ramp rates, and provided an incremental increase in existing flexible generation capabilities. Field-testing and modeling results show that steam well and pipeline corrosion is a major constraint on steam-field operations. However, results from this study will guide economic evaluations and future capital improvements needed to expand the flexible generation capabilities at The Geysers.
EPC-14-003 Low- Cost Thermal Energy Storage for Dispatchable CSP	Pre-existing intellectual property identified in agreement EPC-14-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	University of California, Los Angeles	Group 1: Ranked # 2	N/A	N/A	No	This project will develop a low-cost thermal storage fluid, elemental sulfur, which enables overall low system costs, long lifetime, and scalability for a wide range of concentrating solar power applications.	2a, 3a, 3b, 3h, 4a, 4b	The project performed detailed heat transfer modeling and simulation, laboratory-scale material compatibility experiments, and laboratory-scale thermal battery testing. Results from the laboratory-scale (10 kWh capacity) system were very promising. The system was successfully operated at high temperature (600 degrees Centigrade) over multiple thermal cycles and demonstrated higher energy density and faster dynamic response (speed of charge and discharge) compared to conventional molten salt technology. A pilot-scale (30 kWh capacity) thermal battery system was designed, built, and field tested with CSP in December 2018. Testing the system in a real-world environment validated performance with actual solar energy input and provided valuable validation of system-level analysis and heat transfer tools. Researchers are now scaling up the techno

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-004 Systems Integration of Containerized Molten Salt Thermal Energy Storage in Novel Cascade Layout	Applied Research and Development	The project aimed to build, validate, thermally cycle, and pilot test a modular 75 kW, 6 hour (500 kWh) molten salt thermal energy storage (TES) system, using standard shipping containers and commercially available tanks and insulation. The project leverages a novel cascaded tank arrangement and high-volume manufacturing and factory assembly, to significantly reduce the installed cost of TES for concentrating solar power (CSP).	12/10/2014	No	Generation	$1,500,000	$1,500,000	$377,870	N/A	$377,870	$283,080	$0	Halotechnics	$19,038	1.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-005 Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid	Applied Research and Development	This project aimed to integrate high-accuracy solar forecasting to optimize the operation of distributed energy resources, and utilize the value of solar forecasting in utility grid operations to improve grid reliability, reduce ratepayer costs and increase safety. The objectives were to apply forecasts to inform control and scheduling decisions for distributed energy resources with emphasis on energy storage and electric vehicle charging control at warehouse photovoltaic clusters in the LA-Orange-Riverside-San Bernardino-San Diego Counties as well as the UCSD microgrid.	12/10/2014	No	Generation	$999,984	$999,984	$726,345	N/A	$726,345	$157,282	$0	San Diego Gas & Electric Company; Itron, Inc. dba IBS; University of California, San Diego, San Diego Supercomputer Center; Strategen	$999,984	50.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-007 Improving Short-Term Wind Power Forecasting through Measurements and Modeling of the Tehachapi Wind Resource Area	Applied Research and Development	This project comprises coordinated atmospheric field measurements and computational modeling improvements to improve the accuracy of prediction of short-term wind ramps (i.e. large, rapid changes in wind power production). The Tehachapi Pass Wind Resource Area is the focus of the project. Since the area features complex terrain and meteorology, the findings can be readily adapted and applied to many other regions.	12/10/2014	No	Generation	$1,000,000	$1,000,000	$993,172	N/A	$993,172	$247,542	$84,888	Department of Mechanical and Aerospace Engineering - UC Davis	$90,325	8.3%	Grant

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EPC-14-004 Systems Integration of Containerized Molten Salt Thermal Energy Storage in Novel Cascade Layout	Pre-existing intellectual property identified in agreement EPC-14-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Halotechnics	Group 1: Ranked # 1	N/A	N/A	No	The Halotechnics thermal storage system sought to improve system design and modularity and reduce the cost of molten salt energy storage by 25% by reducing the required storage volume. However, researchers found that the innovative storage technology would have to be very large to cost competitive with battery storage and, therefore, would not effectively reduce the cost of small CSP plants to make them competitive in the market.	1i, 2a, 3b	The project was approved at the December 10, 2014 Energy Commission Business Meeting and the project work was started in January 2015. The process design and the mechanical design of all major components were completed, along with specified control system requirements which included the use of three tanks, the minimum number prescribed to evaluate the operation and viability of a multiple tank system. Halotechnics terminated the project after 10 months prior to the procurement of any hardware due to insufficient commercial traction from customers in the concentrated solar power industry.
EPC-14-005 Solar Forecast Based Optimization of Distributed Energy Resources in the LA Basin and UC San Diego Microgrid	Pre-existing intellectual property identified in agreement EPC-14-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	The Regents of the University of California, San Diego	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The uncontrollable generation of renewable energy sources, such as solar photovoltaics poses numerous challenges to the electric grid. The large growth of electric vehicles (EV) has potential to exacerbate those challenges due to increases in load, especially at inopportune times. However, the flexibility of scheduling EV charging around forecasted PV production provides a solution to this problem. Furthermore, the project improved solar energy forecast accuracy by 10% over the existing persistence forecast method for 10 minute ahead to optimize the operation of distributed energy resources. It will mitigate the concerns of electric operations over the variable nature of solar power that contributes to net load variability, causing voltage issues affecting service quality and reliability.	1c, 4a, 5c	The utility customers who use solar forecasting and smart EV charging could achieve a 67% reduction in energy costs over the year, reducing monthly peak demand by 63%. This study reveals that using aggregated vehicle load large enough to absorb the solar output on the studied circuit is years in the future. The studied circuit showed that connected PV output created an energy valley of 64.5 MWh. Using a typical commuter PEV requiring 7 kWh means that roughly 9,200 vehicles must be connected during the solar output period to create an adequately sized energy sink to absorb the full amount of this oversupply. The executive order B-48-18 will improve the perspectives for EV charging and grid net load balancing in California. But at 929,000 commercial buildings in California, Oregon, and Washington, even 250,000 chargers will fall short of the amounts required in this example.
EPC-14-007 Improving Short-Term Wind Power Forecasting through Measurements and Modeling of the Tehachapi Wind Resource Area	Pre-existing intellectual property identified in agreement EPC-14-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	University of California - Davis	Group 2: Ranked # 4	N/A	N/A	No	Improvements to accuracy of short-term (3-15 hours) and very short-term (0-3 hours) wind ramp forecasting would reduce generating reserves scheduled by grid operators, with corresponding decreases in grid operating costs and greenhouse gas emissions, and, simultaneously, increased grid reliability.	1c, 3b, 5c	The project team has completed the measuring program that included sodar, ceilometer, radiometer, radar wind profiler, and radio acoustic sounder measurements scattered over six sites and completed a forecast sensitivity study of wind ramping behavior based on suite of physics-based predictive models versus observed sodar data, including obtaining results for a sensitivity study of observed bias of mean absolute error of 0-15 hour energy forecast for Tehachapi wind resource area.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-008 High-Fidelity Solar Power Forecasting Systems for the 392 MW Ivanpah Solar Plant (CSP) and the 250 MW California Valley Solar Ranch (PV)	Applied Research and Development	The purpose of this project is to develop and validate tools capable of monitoring and forecasting DNI and POA irradiance and the power generation accurately, from 5 minutes out to 72 hours in the future, at the Ivanpah Solar Thermal plant as well as at the California Valley Solar Ranch (CVSR) plant. The project also included the development of tools for predicting wind speed, which affects the heliostats' deployment, and the improvement of the power generation forecast via Resource-to-Power Model (RTP) for Ivanpah (CSP) and CVSR (Tracking PV) plants. The goal of this system is to reduce uncertainties associated with operation, regulation, and scheduling.	12/10/2014	No	Grid Operations/ Market Design	$999,898	$999,898	$998,828	N/A	$998,828	$168,624	$0	Itron, Inc. dba IBS; NRG Energy, Inc.	$764,019	43.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-009 Optimizing Radiant Systems for Energy Efficiency and Comfort	Applied Research and Development	This project develops new design and operation tools for radiant cooling and heating systems in order to provide standardized guidance for radiant systems in commercial buildings. The agreement includes full-scale laboratory experiments, whole-building simulations, development of simplified models for radiant system controls, validation of these new methods in field studies, occupant satisfaction surveys, and an update to Title-24 for radiant systems. The project produced: 1) a simplified tool for calculating the cooling load and cooling capacity of a radiant slab system, including calculation methods with significant direct solar radiation, 2) a simplified online operational tool for radiant slab systems, and 3) updates to the Title 24 Alternative Calculation Method Reference Manual to enable improved modeling capabilities of radiant systems.	2/25/2015	No	Demand-side Management	$2,939,964	$2,939,964	$2,774,084	N/A	$2,774,084	$450,466	$0	Center for the Built Environment - UC Berkeley; Price Industries	$299,194	9.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-010 Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation	Applied Research and Development	This project (a) quantifies the energy savings, peak demand reduction, urban cooling, and air quality improvements attainable from cool walls in California; (b) assesses the performance of existing cool wall technologies, develops innovative cool wall solutions, and (c) facilitates collaboration among government agencies, utilities, and industry to create a cool-wall infrastructure that includes application guidelines, a product rating program, incentives, and building code credits.	2/25/2015	No	Demand-side Management	$2,500,000	$2,500,000	$2,500,000	N/A	$2,500,000	$908,941	$0	_3M; BEHR; Metal Construction Association; PPG Industries; Saint-Gobain; Sherwin Williams; Tex-Cote; Valspar	$610,800	19.6%	Grant

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EPC-14-008 High-Fidelity Solar Power Forecasting Systems for the 392 MW Ivanpah Solar Plant (CSP) and the 250 MW California Valley Solar Ranch (PV)	Pre-existing intellectual property identified in agreement EPC-14-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	The Regents of the University of California, San Diego	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project introduced a new generation of forecasting methods that fill in a technology gap in the prediction of DNI and POA irradiance as well as solar power generation from PV tracking and CSP. This critical need is evident by the relative scarcity of DNI forecasting algorithms discussed in the scientific literature and the absence of DNI information from the majority of numerical weather prediction models. The development of a network of low-cost sensors for distributed monitoring at California Valley Solar Ranch (CVSR) provides a solution to the need for high-density ground telemetry at low cost. The devices provide an unprecedented level of irradiance sensor density. Forecasting research not only enhances the ability of power plant managers, utility companies and the California ISO to reduce solar costs to ratepayers, but it can also enable higher penetration of renewables.	1c, 4a, 5c	The project demonstrated that the forecasting accuracy for DNI and POA irradiance across all time-scales (intra-hour, intra-day, day-ahead) can be improved using forecasting models that blend local and remote telemetry. The project results demonstrated the importance of having a rich set of input data to improve forecasting. This conclusion was more pronounced for the intra-hour time scale, in which multiple solar sensor data -- including sky images and high-resolution satellite images -- are essential to reduce forecasting errors. The tools developed were used in two very distinct testbeds (Ivanpah and CVSR) to predict irradiance and power generation. In both cases, the forecasting accuracy was improved relative to baseline models. The models were successfully applied to other locations, showing that they can be used in other grid-connected solar farms.
EPC-14-009 Optimizing Radiant Systems for Energy Efficiency and Comfort	Pre-existing intellectual property identified in agreement EPC-14-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	The Regents of the University of California on behalf of the Berkeley campus	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Radiant systems can be an integral part of ZNE and other advanced high performance buildings and reduce energy and peak energy use and cost compared to conventional HVAC systems.	1e, 1f, 1h, 4a	The project is complete. The recipient developed: sizing and operation tools to provide reliable methods to calculate energy performance of radiant systems while maintaining comfort, energy, cost, and comfort data to provide real world examples of energy efficient, affordable, and comfortable buildings using radiant systems, and recommendations for Title-24 and ASHRAE Standards advancements. The research team used full-scale laboratory experiments, whole-building energy simulations and tool development, and field studies and control demonstrations to develop guidance and tools to help the building industry adopt radiant systems. Recommendations for revisions to relevant codes and standards will continue to be communicated to the responsible organizations by the research team, who regularly participate in committees and conferences related to Title-24 and ASHRAE
EPC-14-010 Solar-Reflective "Cool" Walls: Benefits, Technologies, and Implementation	Pre-existing intellectual property identified in agreement EPC-14-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The project is advancing scientific knowledge by quantifying the potential benefits of cool walls, assessing the performance of existing and prototype cool wall technologies, and developing innovative cool wall solutions. High wall albedo can be attained with a reflective coating (e.g., paint or stucco) or cladding. Cool wall products available today include light-colored paints that reflect up to 80% of sunlight when new, but may lose reflectance as they soil; and darker cool colored paints that come in a wide palette, but typically reflect less than 50% of sunlight when new. This project will provide information to building owners, facility managers, and the paint industry on the direct and indirect energy and environmental benefits of solar reflecting walls, assessing and advancing available and emerging cool wall tech	1e, 1f, 1h, 4a, 5d	The project has been completed. The findings from this project indicate that cool walls can reduce whole-building annual HVAC use by up to 25% in single-family, 3.7% in medium offices, and 9% in stand-alone retail stores. The final report will be published in January 2019.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-011 From the Laboratory to the California Marketplace: A New Generation of LED Lighting Solutions	Applied Research and Development	This project focuses on the design and development of innovative LED lighting solutions for three key general illumination product categories. These solutions are a best-in-class medium, screw-base replacement lamp, linear tubular light emitting diode (TLED) replacement lamps and spectrally optimized, dedicated LED luminaires. Product design requirements are based on consumer light quality and functional performance preferences determined through a series of unique laboratory-based consumer preference and product characterization studies.	2/25/2015	No	Demand-side Management	$2,995,187	$2,995,187	$2,826,674	N/A	$2,826,674	$557,072	$5,000	Regents of the University of California, Davis - California Lighting Technology Center	$5,000	0.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-012 Comparing Attic Approaches for Zero Net Energy Homes	Applied Research and Development	The project focused on the performance of different attic assemblies and their associated heating, ventilating and air conditioning (HVAC) systems. Field measurements of attic and HVAC system performance were conducted in two new high performance homes in California with sealed and insulated attics. One home was built to be about 30 percent better than Title 24 and the other is a ZNE home. The attic insulation approach involved a new lower-cost approach using blown insulation that does not use expensive spray-foam. The results of the measurements are used directly to provide technical support for potential changes to Title 24 and provide information to contractors and builders on sealed and insulated attic performance and alternative approaches.	2/25/2015	No	Demand-side Management	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000	$563,439	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-013 Very Low-cost MEMS-based Ultrasonic Anemometer for Use Indoors and in HVAC Ducts	Applied Research and Development	This project develops and tests prototype room and duct anemometers that are low-cost, low power, accurate, calibration-free and compact. The anemometers are wireless, able to be inexpensively installed in existing buildings, can operate on a battery for years and communicate wirelessly via the internet to the building's control system. The technology is expected to save energy by using collected data to correct wasteful HVAC malfunctions that result in inefficient systems and uncomfortable buildings.	2/25/2015	No	Demand-side Management	$2,488,964	$2,488,964	$2,462,263	N/A	$2,462,263	$214,202	$0	Center for the Built Environment - UC Berkeley; BAF Technologies Inc.; Vigilent; Chirp Microsystems, Inc.; Price Industries	$249,000	9.1%	Grant

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EPC-14-011 From the Laboratory to the California Marketplace: A New Generation of LED Lighting Solutions	Pre-existing intellectual property identified in agreement EPC-14-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Regents of the University of California, Davis - California Lighting Technology Center	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	This project could improve understanding of metrics and test procedures associated with LED quality and performance, increase lamp manufacturer's ability to comply with future energy codes and standards and produce good quality LED products and increase consumer acceptance and satisfaction of LED lamps.	1f, 1h, 4a	Widespread adoption of LED lighting for general illumination applications is one of the largest advances in lighting building efficiency. However the focus on cost reductions at the expense of product quality has led to a lack of consumer satisfaction, and minimal market share for LED products in residential and commercial applications. This project designed and developed novel, energy-efficient, LED lighting solutions with quality and performance features that align with consumer expectations. Key research outcomes include: proposed changes to ANSI LED color bins to address consumer expectations, documented consumer preferences for color fidelity, quantification of the impact of color fidelity on visual acuity, and consumer preferences for lighting product packaging and information. These outcomes informed product specifications for linear LED lamps, retrofit kits and luminaires
EPC-14-012 Comparing Attic Approaches for Zero Net Energy Homes	Pre-existing intellectual property identified in agreement EPC-14-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will lead to technological advancement by offering alternative construction techniques for sealing and insulating attics, compared to conventional methods. The alternative technique involves the use of sealed attics and could lead to electricity savings and peak demand savings when compared to conventional duct systems, and also increase occupant comfort. The recipient is working with building developers on these new techniques which will contribute to achieving ZNE goals for new construction. The techniques can also be applied to home retrofits with HVAC equipment.	1f, 1h, 4a	Staff is reviewing the final report and a final project presentation occurred on 12/19/18. The Fresno test home was monitored continuously from September 2016 to the end of April 2018, and the Clovis test home was monitored from June 2017 through mid-May 2018. The Fresno home exceeds California Title 24 energy performance requirements by 30%, while the Clovis home is designed as a net zero-energy home. Over 100 sensors were installed per home, monitoring temperature, relative humidity, heat flux, surface condensation, moisture and HVAC energy use. An improved version of a sophisticated and mature model called Register Capacity (REGCAP) was used to extend results to all of California's 16 climate zones. Preliminary results indicate an average of 18 percent savings in HVAC energy use using these approaches.
EPC-14-013 Very Low-cost MEMS-based Ultrasonic Anemometer for Use Indoors and in HVAC Ducts	Pre-existing intellectual property identified in agreement EPC-14-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	The Regents of the University of California on behalf of the Berkeley campus	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The ability to accurately control airflow with these low cost sensors can expand the comfortable temperature setpoint range in air-conditioned buildings, such as allowing the setting higher indoor temperatures while still being comfortable. This can facilitate more efficient operation of building HVAC systems, resulting in an estimated savings of 183 GWh/yr and 52,000 metric tons CO2e/yr.	1f, 1h, 2a, 3a, 4a	This project has completed and the final report is under review. The recipient produced a prototype anemometer that is disruptively low cost, calibration free, accurate and uses low energy. A number of manufacturers may be interested in the ultrasonic technology and a provision patent was filed through University. A major control manufacturer signed a Non-Disclosure Agreement. The agreement laid the groundwork for further commercial development. The recipient continues to engage with potential manufacturers.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-015 Direct Current as an Integrating and Enabling Platform	Applied Research and Development	This project evaluates DC and AC-DC hybrid applications to determine market segments where projects are technically and economically feasible. The research covers existing and new buildings. For the market segments identified, the Team is developing and piloting tools to help building developers incorporate these systems into their building designs. The tools include DC and AC-DC hybrid design guidelines, and design templates.	2/25/2015	No	Demand-side Management	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000	$495,365	$0	EMerge Alliance; California LMCC IBEW-NECA	$100,000	9.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-016 Cost- and Energy-Efficient Attic Designs for California Homes	Applied Research and Development	This project evaluates, tests and refines two different attic designs in California homes, and recommends the best approaches to home builders addressing cost-effectiveness and energy-efficiency. The baseline will be the current energy efficiency code practices for ventilated roof attics with no additional attic insulation and ducts within the attic that comply with the current energy code (2013) requirements for ducting.	2/25/2015	No	Demand-side Management	$1,000,000	$1,000,000	$774,029	N/A	$774,029	$228,148	$0	Owens Corning	$265,000	20.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-017 Developing Flexible, Networked Lighting Control Systems That Reliably Save Energy	Applied Research and Development	The recipient is developing low-cost lighting components with open communication interfaces, that allow seamless integration into whole-building control and automation systems. The project targets future California Building Energy Efficiency Standards (Title 24), and establish methods by which the site-specific configuration and operation of networked lighting controls systems can be effectively addressed, and more easily implemented in the marketplace.	2/25/2015	No	Demand-side Management	$1,875,000	$1,875,000	$1,875,000	N/A	$1,875,000	$216,162	$0	None	$0	0.0%	Grant

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EPC-14-015 Direct Current as an Integrating and Enabling Platform	Pre-existing intellectual property identified in agreement EPC-14-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The potential energy savings and interoperability advantages of DC and AC-DC hybrid systems are estimated to be significant, especially for zero net energy (ZNE) buildings that integrate on-site renewable energy with battery storage and electric vehicle (EV) charging. Prior research estimates energy savings potential of 10% to 30% for DC-powered ZNE buildings that incorporate storage and or EV charging. This project will help accelerate the adoption of DC and AC-DC hybrid applications by compiling existing knowledge, identifying standards and technology gaps, designing tools and identifying a path forward to help ensure successful outcomes for DC and AC-DC hybrid applications in key market segments from which these systems can scale.	1f, 1h	The project is complete. Results indicate that no technology breakthroughs are needed to make DC power distribution a viable option for zero net energy buildings. There are, however, many barriers to the adoption of DC power, with product availability and cost as the most significant ones. There also is a general unfamiliarity with DC power in the building community, from designers to code officials, contractors, tradespeople, maintenance staff, building owners, occupants, and policy makers. The recipient indicates that there is a real need for DC power market development in the form of product standards, building and fire codes that explicitly account for DC systems, DC specific design practices, improved trade familiarity, and a wider variety of DC ready products in a range of product categories, feature sets and capacities. The final report will be published in January 2019.
EPC-14-016 Cost- and Energy-Efficient Attic Designs for California Homes	Pre-existing intellectual property identified in agreement EPC-14-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	BIRA Energy	Group 3: Ranked # 2	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity	Methods to improve the efficiency of building envelopes have included sealed, insulated attics as well as standard vented attics but are in limited use in the market today. However, these approaches add considerable cost to builders under current practices. The research team is employing new and novel installation methods and materials, which include low cost fiberglass insulation with boxed netting and integral vapor retarder, that have the potential for energy savings on par with ducts in the conditioned space, but at a cost similar to current construction practices.	1f, 1h, 4a	The recipient instrumented three existing homes in the City of Rio Vista with the following attic approaches: Vented with R-38 on the ceiling, Sealed with box netted R-38 under roof deck, and vented with R-38 on the ceiling and R-19 under roof deck. The monitoring started in August 2018. Unfortunately, the grant expired on June 30, 2018. The Energy Commission staff and the recipient are exploring options for obtaining the monitored data and results for the homes and concluding the project.
EPC-14-017 Developing Flexible, Networked Lighting Control Systems That Reliably Save Energy	Pre-existing intellectual property identified in agreement EPC-14-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 6	N/A	N/A	Yes; Calif Based Entity	The research focus is on how low cost sensing and distributed intelligence can enhance energy efficiency and enable distributed points of controls that result in greater energy savings and more accurate energy reporting. The research will result in the design and development of a new innovative desk lamp with localized sensing and user control of overhead ambient lighting. This innovative technology alters the lighting retrofit landscape by inexpensively enabling highly granular lighting control at the occupant's fingertips (previously only zone-level control existed), to control overhead lighting. In addition, this technology can be enhanced with sensors to measure occupants circadian lighting exposure to enable system control to ensure human health and productivity is optimized while maximizing energy efficiency attributes.	1f, 1h, 4a	This project developed a suite of networked lighting solutions to reduce lighting energy use in buildings: a) a low-cost sensing, distributed intelligence and communications platform, the "PermaMote," b) a task ambient daylighting system that integrates sensors with data-driven daylighting control using an open API, c) a new method for evaluating and specifying lighting systems' performance, d) a proposed lighting data model and user interface elements, which contributed to the ANSI Lighting Systems Committee (C137), and e) a metric for capturing the actual energy impact of a lighting system over time. Laboratory validation of the technologies showed significant energy savings, up to 73% for the PermaMote sensor system. These advanced technologies can reduce California commercial-building lighting energy use by 60-80% or about 1,500 GWh/year in savings.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-019 Validated and Transparent Energy Storage Valuation and Optimization Tool	Applied Research and Development	This project developed, tested, and validated a publicly available computer model for the CPUC's energy storage use cases that determines the most optimal energy storage systems. This software model successfully assesses costs and benefits and guides energy storage projects with respect to location, size, and type. The software is publicly released as a cloud-hosted tool.	3/11/2015	No	Grid Operations/ Market Design	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000	$482,416	$0	Electric Power Research Institute, Inc.	$901,944	47.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-021 Development and Testing of the Next Generation Residential Space Conditioning System for California	Applied Research and Development	This project is designing and testing a residential heat pump space-conditioning system at 3 homes across California. The advanced efficiency solutions integrated into the HVAC system will include: variable-capacity compressor and variable-speed fans using state-of-the-art inverter technology; integrated ventilation to harness fresh air for "free cooling;" intelligent dual-fuel technology to decrease energy cost and empower consumers to choose between electricity and natural gas; zonal control to prevent conditioning of unoccupied rooms; demand-response interactivity to grid flexibility and reliability; advanced fault detection and diagnostics to ensure proper installation, operation, and maintenance; and alternative refrigerants for improved operation and significant reductions in the potential for global warming.	4/8/2015	No	Demand-side Management	$2,993,005	$2,993,005	$2,981,202	N/A	$2,981,202	$1,072,105	$0	Electric Power Research Institute, Inc.	$322,281	9.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-022 The Lakeview Farms Dairy Biogas - To - Electricity Project	Technology Demonstration and Deployment	ABEC #3 LLC, DBA Lakeview Farms Dairy Biogas is installing and demonstrating an innovative covered lagoon digester system that will process dairy manure into biogas to generate renewable electricity for export to the electricity distribution grid. This particular project is located near 11 other dairies and will help launch the state's first "hub-and-spoke" dairy digester cluster by preparing the 1 MW generator platform to accept 2 MWs of future capacity, potentially utilizing biogas from neighboring dairies and providing a means to off-take gas for vehicle fuel use. This hub and spoke approach was initially proposed in a case study prepared for the USDA on the economic feasibility of dairy digester clusters in California. The idea is to allow the dairies to benefit from the aggregation of capital investment and reduce operation and management costs by centrally locating the generators and associated electrical equipment.	3/11/2015	No	Generation	$4,000,000	$4,000,000	$3,951,593	N/A	$3,951,593	$29,498	$2,000,000	ABEC #3 LLC, dba Lakeview Farms Dairy Biogas	$4,500,000	52.9%	Grant

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EPC-14-019 Validated and Transparent Energy Storage Valuation and Optimization Tool	Pre-existing intellectual property identified in agreement EPC-14-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This agreement developed a "first of its kind" publically available tool that determines the value of energy storage with respect to location, size, and type.	1c, 1i, 2a, 4a, 5b	The project successfully ended on December 30, 2016, and the final report was published. The final report can be seen at: http://www.energy.ca.gov/2017publications/CEC-500-2017-016/CEC-500-2017-016.pdf. After project was completed, ongoing outreach activities continue. For example, the tool was presented to NYSERDA for testing, and a meeting was held between the CEC and CPUC staff to present the tool's capabilities and its potential adoption for future procurement decisions. Additionally, the California Energy Commission held a public workshop for the purpose of training and obtaining feedback for future refinement of the tool.
EPC-14-021 Development and Testing of the Next Generation Residential Space Conditioning System for California	Pre-existing intellectual property identified in agreement EPC-14-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 8	N/A	N/A	Yes; Calif Based Entity	This project developed a climate optimized HVAC system that includes advanced energy efficiency features integrated into a single unit. The technology could reduce electricity use, demand and costs, enhance occupant comfort, and allow the use of alternative refrigerants that reduce the potential for global warming.	1e, 1f, 1g, 1h, 4a	The project has been completed. The recipient developed a residential space conditioning system that integrates advanced HVAC technologies including: a variable capacity compressor and blower, automated demand response, fault detection and diagnostics, intelligent dual fuel heating, integrated ventilation, and zonal control. An alternative refrigerant, R-32, was evaluated as a possible future enhancement. An assessment was performed on duct losses for single versus multi-zone duct configurations with variable capacity equipment. The report find that the system could potentially save 22-32% of cooling energy compared to a 14 SEER single speed system, as well as satisfying over 90% of annual heating load for most of California without electrical or natural gas back-up. Daikin/Goodman, the product's manufacturer, will take the project results to consider iterations of their future products.
EPC-14-022 The Lakeview Farms Dairy Biogas - To - Electricity Project	Pre-existing intellectual property identified in agreement EPC-14-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	ABEC #3 LLC, dba Lakeview Farms Dairy Biogas	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project will significantly reduce methane emissions and generate renewable electricity, helping to achieve the state's greenhouse gas emission reductions and renewable electricity goals. Demonstrating the effectiveness of the innovative hub and spoke model could lead to the development of more California dairy digester biogas-to-electricity and biogas-to-fuels projects. The improved digester design will decrease dairy operating costs and provide valuable co-products, such as nutrient-rich irrigation water.	3a, 4a, 4e	The project broke ground in fall 2016 and construction was completed. The project accepted a PG&E 20-year Power Purchase Agreement and began testing in the fourth quarter 2017, with full operation and data collection commencing in the first quarter of 2018. A ribbon-cutting event was held in February 2018. The project has been operating and has collected operational data for one year. Electrical production from the digester exceeded expected production during 2018. Annual electrical production was more than 1,500 kilowatt-hours per milk cow equivalent. The project was completed in March 2019.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-023 Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits	Applied Research and Development	The purpose of this agreement is to fund the development of an emerging energy storage technology, a zinc hybrid cathode battery (Znyth), and demonstrate the performance of this technology for distribution-connected applications in partnership with a utility. Eos has been selected by Pacific Gas and Electric (PG&E) under the AB 2514 Energy Storage Mandate Procurement to provide a 10MW/40MWH system in 2020. The test results of this grant are important to keep this larger utility commercial procurement on schedule. They are also valuable to the CPUC to demonstrate alternatives to Li-ion storage for distribution applications.	4/8/2015	No	Distribution	$2,156,704	$2,156,704	$1,927,382	N/A	$1,927,382	$691,504	$0	Electric Power Research Institute, Inc.; Eos Energy Storage, LLC	$1,167,607	35.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-024 Modular Biomass Power Systems to Facilitate Forest Fuel Reduction Treatment	Applied Research and Development	This project develops and tests a modular biomass gasification system that can be rapidly deployed to communities across California to promote and support fire-safe management activities.	3/11/2015	No	Generation	$2,000,000	$2,000,000	$1,944,894	N/A	$1,944,894	$330,466	$1,200,001	TSS Consultants; West Biofuels, LLC ; Christiana Darlington; Soper-Wheeler Co. LLC	$730,148	26.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-025 Mass-manufactured, Air Driven Trackers for Low Cost, High Performance Photovoltaic Systems	Applied Research and Development	The project aimed to install and test a 300 kW photovoltaic solar system with air-driven trackers. Two key technical innovations were demonstrated. First, the use of mass-manufacturing for the drive system results in an extremely low cost structure and very low part count. Second, only tubing is connected to each actuator, removing requirements for outdoor wiring or individual control hardware. The research involved collecting six months of performance data for the solar PV tracking technology.	3/11/2015	No	Generation	$1,000,000	$1,000,000	$989,116	N/A	$989,116	$157,497	$0	PV Evolution Labs; Sunfolding, Inc.	$1,171,565	54.0%	Grant

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EPC-14-023 Utility Demonstration of Znyth Battery Technology to Characterize Performance and Grid Benefits	Pre-existing intellectual property identified in agreement EPC-14-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Eos Energy Storage, LLC	Group 2: Ranked # 1	N/A	N/A	No	Eos is the only company offering a zinc hybrid cathode battery, under the trademark name Znyth. This is an aqueous, zinc-based battery technology that is inherently safer than competing technologies. This technology is non-flammable and non-toxic. In addition to being backed by UL- and ISO-certified quality assurance and control, the manufacturing process involves no toxic or hazardous materials. This demonstration will provide information and data to assess the value and cost savings of utility-scale battery energy storage when interconnected to the grid.	1c, 1i, 2a, 4a, 5b	Due to unforeseen circumstances in early 2019, Eos was unable to continue testing the Generation 2 system with PG&E in San Ramon. Instead, Eos found a new utility test partner and test site with SDG&E in Pala, San Diego County. Eos is working with SDG&E to conduct the testing originally planned with PG&E. In October, preparations began for installation, commissioning, testing and evaluation of the Generation 2 system at SDG&E's Playa del Norte site and testing will continue through the middle of 2020. A draft final report has been completed and is currently under revision.
EPC-14-024 Modular Biomass Power Systems to Facilitate Forest Fuel Reduction Treatment	Pre-existing intellectual property identified in agreement EPC-14-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	West Biofuels, LLC	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project is driving innovation in the bioenergy market for forest residue conversion to renewable grid power by advancing the modular gasification technology system design and integration with a high-efficiency lean-burn engine. The modular system has the potential to reduce the cost and increase the benefits of forest fuel reduction projects in high fire risk regions of the state. The project sought a technological solution to support California goals including healthy forest management, protection of electricity infrastructure, and production of renewable electricity.	1a, 1c, 4a	The project yielded important results that did not support the initial hypothesis that the recipient's CircleDraft gasification system was appropriate for the California market. However, the project did result in the development of a more robust modular system (rotary gasifier integrated to an Organic Ranking cycle (ORC) generator) that addressed critical technical challenges experienced with the initial system including material flow issues associated with forest material, associated producer gas output and quality fluctuations, and high engine generator maintenance requirements. Based on testing done with match funds, the rotary gasifier + ORC generator configuration is ready for a commercial technology demonstration in a California forest sector community.
EPC-14-025 Mass-manufactured, Air Driven Trackers for Low Cost, High Performance Photovoltaic Systems	Pre-existing intellectual property identified in agreement EPC-14-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Sunfolding Inc.	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The PV solar tracking technology tested and validated in this project will result in ratepayer benefits of reduced cost of energy and increased energy supply reliability. The air-driven trackers not only reduce the direct product cost to the customers, but also simplify every step in the project lifecycle (i.e., development, construction, and operation). The reduced cost of energy will be achieved by the innovative solar tracking technology that adds 15-25% more power over fixed tilt systems at a cost that is well below the cost of current solar trackers. The increases in energy supply reliability will be achieved by delivering additional power that occurs in the late afternoon to the grid.	2a, 3b, 4a	The project team successfully installed and tested the 300kW PV tracking system in the field. The site was instrumented with sensors, cameras, and data collection equipment. The team installed distributed position sensors to gather temporal positioning and providing tracker consistency data, high accuracy air pressure sensors to assess pneumatic performance, and a video monitoring system to enable remote visual monitoring. The team collected data for more than six months and concluded that the system exceeded expectations in tracker performance, accuracy, and uptime. The team developed several generations of the actuator over the life of the project, which did not experience component failures during the demonstration activities. EPIC funding was critical to advancing Sunfolding's commercialization efforts, allowing to build a track record and establish reliability and bankability.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-026 Examining the Heterogeneity of Energy Efficiency Adoption and Savings Across Socio-Economic and Ethnic Groups Using a Large Scale Quasi-Experiment	Market Facilitation	This project conducted a quasi-experimental, econometric study of energy efficiency adoption and energy savings with a focus on differences between social, cultural, and socio-economic groups. The study applied modern economic methods to Southern California Edison's Quality Installation Program, including regression-discontinuity and propensity score matching. The large data sets and rigorous methods resulted in estimates to improve demand forecasts, energy efficiency program design, and future energy studies concerning social, cultural, and socioeconomic groups.	4/8/2015	No	Demand-side Management	$360,632	$360,632	$360,584	N/A	$360,584	$65,406	$0	The Regents of the University of California, Berkeley	$150,784	29.5%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-027 High Temperature Hybrid Compressed Air Energy Storage (HTH-CAES)	Applied Research and Development	This project designed a low-cost 74kW pilot High Temperature Hybrid Compressed Air Energy Storage (HTH-CAES) system that can efficiently store grid-level energy and release that energy when it is needed to meet peak demand, particularly for ancillary services and load following use-cases. This project documented and reported on the design, anticipated performance and lessons learned of the HTH-CAES system to increase knowledge and understanding of how these storage systems perform and the barriers to siting and operations.	4/8/2015	No	Distribution	$1,621,628	$1,621,628	$632,754	N/A	$632,754	$206,222	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-028 Low Cost Biogas Power Generation with Increased Efficiency and Lower Emissions	Applied Research and Development	This project deployed a pre-commercial technology demonstrating a sorbent-based biogas purification process for combined heat and power generation at the pilot scale that removes multiple troublesome impurities from biogas, upgrading the fuel to near-pure methane for combustion in conventional prime movers. The pilot plant was installed and tested at a landfill site to demonstrate the environmental and cost benefits of biogas purification prior to use in combined heat and power applications.	3/11/2015	No	Generation	$1,318,940	$1,318,940	$1,236,591	N/A	$1,236,591	$105,570	$0	ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.; Waste Management of California, Inc.; InnoSepra, LLC	$959,150	42.1%	Grant

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EPC-14-026 Examining the Heterogeneity of Energy Efficiency Adoption and Savings Across Socio-Economic and Ethnic Groups Using a Large Scale Quasi-Experiment	Pre-existing intellectual property identified in agreement EPC-14-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	The Regents of the University of California, Berkeley	Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) set energy efficiency targets for 2030 and allowed for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project team recommended designing future residential energy efficiency programs that target low-income customers in hot climate zones, and account for time-of-use rates in California. Key findings that led to these recommendations were that hot climate zone was a huge factor in getting customers to participate in this HVAC program, low-income households experienced greater savings because existing household appliances were usually less efficient and more noticeably improved, and that energy savings, due to participating in the program, were the greatest between the hours of 3-9 pm in the months of August and September due to peak demand rates.	2a, 5c	The project team submitted its Final Report in March 2017, and had its final meeting in July 2017. Project findings suggest that: climate is the strongest variable for customer participation in t SCE's Quality Installation Program (participants in hot areas saved ~1100 kWh annually, compared to 300 kWh in warm areas and 0 in mild areas), savings were higher for lower income homes than for high income homes but lower income homes participated less frequently, the most significant hours for achieving energy savings were shown to be 3-9 pm, and that future energy efficiency programs should be focused on increasing participation of low-income homes in hot areas.
EPC-14-027 High Temperature Hybrid Compressed Air Energy Storage (HTH-CAES)	Pre-existing intellectual property identified in agreement EPC-14-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Regents of the University of California, Los Angeles	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	Compressed air energy storage may be a viable solution for long-term and large-scale storage applications. HTH-CAES potentially has lower capital and maintenance cost and less geographic restrictions than other storage technologies. In the HTH-CAES technology, compressors are used to convert inexpensive off-peak electric power into compressed air and thermal reservoirs.	1c, 1i, 2a, 4a, 5b	The design of a 74kW HTH-CAES system was completed and is ready for a future demonstration. The final report includes a description of the piping and instrumentation, the mechanical/thermal design of the energy storage, and the completed 3D layout of the plant. All major components for construction were purchased, several patents were developed and journal articles were published. The final report is being prepared for publishing on the Commission website.
EPC-14-028 Low Cost Biogas Power Generation with Increased Efficiency and Lower Emissions	Pre-existing intellectual property identified in agreement EPC-14-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	InnoSepra, LLC	Group 2: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The project is advancing an innovative gas clean-up system based on a temperature swing adsorption concept that adsorbs carbon dioxide and other contaminants while letting methane pass through and that regenerates the adsorbent bed, resulting in lower cost of operation. Converting biogas to high purity biomethane enables its use in premium efficient devices for power generation, thereby helping reduce the cost of electricity. This technological approach will help meet renewable electricity goals at a lower cost and will enable use of marginal biogas sources for power generation applications using conventional natural-gas fired prime movers.	1a, 1b, 3g, 4a, 4b	InnoSepra's gas conditioning system was upgraded and delivered to the Simi Valley landfill in September, 2018. The system has been functioning as designed, and the project team has focused on accumulating hours of operation. InnoSepra was unable to make a second deployment at a digester site due to time constraints. The outcome at the landfill site shows that the absorption process is capable of upgrading landfill gas with up to 200 ppm hydrogen sulphide to renewable natural gas. Economic modeling suggests that the temperature swing regeneration will reduce process power consumption by 50%, resulting in significant cost reduction compared to alternative processes (amine absorption, membranes, pressure-swing absorption).

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-029 The West Star North Dairy Biogas-to - Electricity Project	Technology Demonstration and Deployment	This project advances digester design by building and demonstrating an innovative, double-cell covered lagoon digester and 1-megawatt (MW) generation system. The system will convert dairy manure into biogas and store the biogas above the primary and secondary lagoons under an inflatable cover. The biogas will be converted into renewable electricity and sold for export to the PG&E distribution grid. Further, dairy biogas systems qualify for participation in the CPUC's Assembly Bill (AB) 2514 electricity storage program. In a future phase, the biogas system may compete for an energy storage contract. The project will also improve groundwater protection by minimizing leaching of manure into the groundwater.	3/11/2015	No	Generation	$4,000,000	$4,000,000	$3,998,164	N/A	$3,998,164	$32,107	$0	ABEC #2 LLC, dba West Star North Dairy Biogas	$5,000,000	55.6%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-030 Paths to Sustainable Distributed Generation Through 2050: Matching Local Waste Biomass Resources with Grid, Industrial, and Community Levels	Applied Research and Development	This project highlights locations where waste biomass can be used most efficiently and sustainably for distributed generation by developing scenarios through 2050 that identify the most promising opportunities for waste biomass distributed generation (DG), identifying key technical and regulatory hurdles to waste biomass DG utilization, developing tools for matching available waste biomass resources with energy production opportunities, and suggesting solutions for achieving cost parity with fossil fuels.	3/11/2015	No	Generation	$1,500,000	$1,500,000	$1,500,000	N/A	$1,500,000	$670,276	$900,000	Energy Bioscience Institute; Allotrope Partners; PepsiCo R&D	$282,000	15.8%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-031 Pollution Control and Power Generation for Low Quality Renewable Fuel Streams	Technology Demonstration and Deployment	The project proposed to use a 250 kW gas turbine system that converts relatively dirty, low heating value fuels into heat using gradual oxidation. This gradual oxidation technology was developed by Ener-Core, a California company, and has been demonstrated in operating systems for well over 500 hours, but has not yet been commercially deployed in California. The site for the demonstration was a closed landfill producing low quality gas that was flared. This site was a good match for the 250 kW demonstration as it eliminated the need for flaring of the otherwise unusable gas while generating electricity. However, due to issues with the major subcontractor and technology provider Ener-Core, the project scope was not completed by the end of the agreement term.	4/8/2015	No	Generation	$1,499,386	$1,499,386	$1,020,425	N/A	$1,020,425	$145,560	$0	Advanced Power and Energy Program (APEP) - University of California, Irvine; ES Engineering, Inc. formerly Environ Strategy Consultants, Inc.; Ener-Core, Inc.	$438,345	22.6%	Grant

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EPC-14-029 The West Star North Dairy Biogas-to - Electricity Project	Pre-existing intellectual property identified in agreement EPC-14-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	ABEC #2 LLC, dba West Star North Dairy Biogas	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project demonstrates an improved digester design with a double cell lagoon for greater biogas storage and on-demand generation potential and, if successfully scaled up, establishes dairies as competitors for storage contracts. The improved system will decrease dairy and digester operating costs while also enhancing the protection of groundwater. Other important benefits include: lowered manure handling costs and valuable co-products, such as nutrient-rich irrigation water.	3a, 4a, 4e	The project broke ground in fall 2016 and construction is complete. The project accepted a 20-year PG&E BioMAT Power Purchase Agreement and is collecting data, with full operation commencing in the first quarter of 2018. The project has collected operational data for a full year. The data collection system built into this digester and engine-generator system will be valuable in operating the digester technology. The project was completed in March, 2019.
EPC-14-030 Paths to Sustainable Distributed Generation Through 2050: Matching Local Waste Biomass Resources with Grid, Industrial, and Community Levels	Pre-existing intellectual property identified in agreement EPC-14-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This analysis (1) identifies high-priority areas within California and feedstock types for further public deployment funding, (2) highlights promising geographic areas or available technologies to encourage increased investment in waste biomass DG by the private sector, and (3) improves efficiency and reduces environmental burdens by helping to minimize biomass transportation distances and maximize the efficiency of power production and waste heat utilization.	3c, 4a	The project team developed 2020 (near-term) and 2050 (long-term) scenario projections for waste biomass supply in California. They also developed a county-level monthly wet and dry California biomass inventory and assessed the energy generation potential from food waste in California. The team has estimated energy demand density and identified areas with district heating and cooling potential by using a building stock turnover model along with energy use intensity factors. The project developed a biositing tool for evaluation of potential waste-to-energy sites based on resource availability, potential for waste heat use, and economic and environmental metrics. The project was completed in March, 2019. The information that is available, e.g. biositing, is a web-based tool, various biomass associations, project developers and other stakeholders plan to use it.
EPC-14-031 Pollution Control and Power Generation for Low Quality Renewable Fuel Streams	Pre-existing intellectual property identified in agreement EPC-14-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	University of California, Irvine	Group 1: Ranked # 1	N/A	N/A	No	If the project was successful, it would have demonstrated and deployed a novel gradual oxidation system in conjunction with a gas turbine that is capable of converting low-grade, and otherwise unusable, landfill biogas into renewable electricity.	1a, 1c, 3a, 3h, 4a, 4b	Site engineering, drawings, and permitting requirements were completed in early 2016. An interconnection study with two supplemental reviews was completed by Southern California Edison in late 2016. The study identified the need for substation upgrades and an interconnection cost which far exceeded the budgeted amount. Consequently, the project sought a new landfill host site to demonstrate the novel gradual oxidation technology. A new site (with an existing interconnection agreement) was found and confirmed in mid-2017. However, the equipment installation continued to be delayed due to issues with a major subcontractor and the equipment developer, Ener-Core. In December 2018, CEC staff learned that due to funding issues, Ener-Core was not able to move forward with the project. A stop work order was issued in December 2018 and the project term ended with an unfulfilled scope.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-032 Capturing Cultural Diversity in California Residential Energy Efficiency Potential: An Energy Ethnography of Hispanic Households	Market Facilitation	This project focused on reaching Hispanic subpopulations in California to better understand the social, cultural, and behavioral aspects of their decisions to adopt energy efficient technologies and behaviors. The study combined data collected from participants via energy usage journals, in-home interviews, and energy meters to further the knowledge of Hispanic cultural associations and beliefs related to energy use decisions and choices. The information gathered in this study can be used to improve the metrics and assumptions underlying energy demand forecasting and energy efficiency potential and goals studies. In addition, the study provided information that can be used for targeted marketing of energy efficiency programs to the Hispanic population and improved levels of service to these households.	4/8/2015	No	Demand-side Management	$224,593	$224,593	$224,370	N/A	$224,370	$10,681	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-033 ** North Fork Community Power Forest Bioenergy Facility Demonstration	Technology Demonstration and Deployment	The goal of the North Fork Forest Bioenergy project is to demonstrate a 1 megawatt (MW) forest waste bioenergy gasification-to-electricity facility. The biomass gasification facility is targeted to be a commercial-scale, community-based facility capable of accepting and processing wood waste from forest management that would otherwise create wildfire and air quality challenges, and generating renewable grid-connected electricity. Once the gasification is fully installed and operational, the project team will investigate critical performance parameters and evaluate individual components and protocols to improve performance and reduce operating costs.	4/8/2015	No	Generation	$3,225,773	$3,225,773	$3,225,772	N/A	$3,225,772	$87,680	$0	TSS Consultants; The Watershed Research and Training Center; North Fork Community Development Council; Phoenix Energy; Yosemite Sequoia Resource Conservation and Development Council; Western Energy Systems; USDA Forest Service - Sierra National Forest; Kamalesh Doshi	$1,361,360	21.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-14-033 ** North Fork Community Power Forest Bioenergy Facility Demonstration	Technology Demonstration and Deployment	The goal of the North Fork Forest Bioenergy project is to demonstrate a 1 megawatt (MW) forest waste bioenergy gasification-to-electricity facility. The biomass gasification facility is targeted to be a commercial-scale, community-based facility capable of accepting and processing wood waste from forest management that would otherwise create wildfire and air quality challenges, and generating renewable grid-connected electricity. Once the gasification is fully installed and operational, the project team will investigate critical performance parameters and evaluate individual components and protocols to improve performance and reduce operating costs.	4/8/2015	No	Generation	$1,739,647	$1,739,647	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant

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EPC-14-032 Capturing Cultural Diversity in California Residential Energy Efficiency Potential: An Energy Ethnography of Hispanic Households	Pre-existing intellectual property identified in agreement EPC-14-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	Inova Energy Group, LLC	Ranked # 3	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of the Hispanic subpopulation that discourage or prevent their participation.	1f, 1h, 5c	This project was completed in 2018. Key findings show that participants' energy-related behaviors were heavily influenced by family and community. For example, extended family members living under the same roof lead to variances in energy behaviors. Subtler implications include the use of energy to prioritize comfort for elderly family members. The study also found that participants did not tend to focus on the technical capabilities of energy-efficiency equipment or home envelope improvements, instead the focus was on behavior. For example, participants reported manually turning on and off their air conditioners rather than relying on the thermostat. The results of this project have been shared with IOU energy efficiency program managers and community based organizations to help increase Hispanic participation in energy efficiency programs.
EPC-14-033 ** North Fork Community Power Forest Bioenergy Facility Demonstration	Pre-existing intellectual property identified in agreement EPC-14-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	The Watershed Research and Training Center	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This commercial-ready gasification technology has not been previously demonstrated in California. Combined with the producer gas cleanup system, automation and control, and optimized operation, this innovative system will prove distributed, woody biomass-fueled electricity to be economically feasible and capable of operating for 7,000 hours a year. The project will be grid-connected and will provide immediate benefits, including increased renewable generation capacity, expanded technical resources, and community environmental, wildfire, and economic development benefits.	1a, 1c, 2a	A Stop Work Order was put in place in September 2017 because of delays in equipment delivery and site construction due to lack of financing. The power purchase agreement with PG&E was approved in November 2017. Equipment from GE was delivered but was never installed, and as of August 2019, GE abandoned its gasifier and will not move forward. Phoenix Energy have since identified another gasifier company EQTEC and claimed to have obtained € 2.2M in equity investment. As of end of October 2019, the project team have not reported the status of bond investment, one of the major remaining hurdles to move the project forward. With the loss of GE support, Phoenix is effectively starting anew and therefore the project will not be completed by the current extended term of March 2020.
EPC-14-033 ** North Fork Community Power Forest Bioenergy Facility Demonstration	Pre-existing intellectual property identified in agreement EPC-14-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	The Watershed Research and Training Center	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This commercial-ready gasification technology has not been previously demonstrated in California. Combined with the producer gas cleanup system, automation and control, and optimized operation, this innovative system will prove distributed, woody biomass-fueled electricity to be economically feasible and capable of operating for 7,000 hours a year. The project will be grid-connected and will provide immediate benefits, including increased renewable generation capacity, expanded technical resources, and community environmental, wildfire, and economic development benefits.	1a, 1c, 2a	A Stop Work Order was put in place in September 2017 because of delays in equipment delivery and site construction due to lack of financing. The power purchase agreement with PG&E was approved in November 2017. Equipment from GE was delivered but was never installed, and as of August 2019, GE abandoned its gasifier and will not move forward. Phoenix Energy have since identified another gasifier company EQTEC and claimed to have obtained € 2.2M in equity investment. As of end of October 2019, the project team have not reported the status of bond investment, one of the major remaining hurdles to move the project forward. With the loss of GE support, Phoenix is effectively starting anew and therefore the project will not be completed by the current extended term of March 2020.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-034 Interra Reciprocating Reactor for Low-Cost & Carbon Negative Bioenergy	Applied Research and Development	The purpose of this was to install and demonstrate an advanced modular bioenergy technology. The pilot-scale demonstration was intended to help determine if the performance of the technology, along with biomass co-product value creation enhancement strategy, was sufficiently powerful to overcome the affordability burdens that currently block the feasibility of distributed generation bioenergy projects in California.	4/8/2015	No	Generation	$2,000,000	$2,000,000	$1,353,332	N/A	$1,353,332	$264,400	$0	Interra Energy, Inc.	$4,627,400	69.8%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-035 Demonstration of integrated photovoltaic systems and smart inverter functionality utilizing advanced distribution sensors	Applied Research and Development	The project team developed, demonstrated, and evaluated at the LBNL Facility for Low Energy Experiments (FLEXLAB) test bed the ability of a smart inverter controller to enhance and optimize grid support and system performance of an integrated pilot scale of an advanced PV and storage system. The system includes a 14 kilowatt (kW) PV system and 19 kWh of battery storage. The project team evaluated the use of distribution synchrophasor unit data to support specific visualization and control applications on distribution circuits.	4/8/2015	No	Grid Operations/ Market Design	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000	$375,000	$0	Tesla, Inc.	$25,000	2.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-036 Smart Inverter Interoperability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage	Applied Research and Development	The project developed a smart solar PV-based DER system showing a pathway for distributed energy resources to achieve critical mass and enable solutions for California's grid. The work included the development of a CA Rule 21 test framework and test scripts; compliance testing of smart inverters with functionality as described in the CPUC CA Rule 21 Smart Inverter Working Group (SIWG) recommendations; monitor and control inverter operating functions, including participation in ancillary service for diverse DER assets. The project delivered a smart inverter test framework and open-source software tools to enable rapid product development and safety testing and demonstrated the benefits to all stakeholders including ratepayers, utilities, manufacturers, investors and operators.	4/8/2015	No	Grid Operations/Market Design	$2,000,000	$2,000,000	$1,992,095	N/A	$1,992,095	$162,005	$0	SunSpec Alliance; Kitu Systems	$2,066,875	50.8%	Grant

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EPC-14-034 Interra Reciprocating Reactor for Low-Cost & Carbon Negative Bioenergy	Pre-existing intellectual property identified in agreement EPC-14-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Interra Energy, Inc.	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	If successful, this project could help stabilize the grid, improve service reliability, and reduce the risk of forest fire. Advanced bioenergy systems that produce useful co-products can also reduce the cost of renewable energy procurement and mitigate the GHG impacts of energy generation.	1c, 4a, 4b	The project faced serious technological challenges and Interra Energy was unable to demonstrate progress towards meeting the project requirements. The Energy Commission determined that results from the bioenergy system are not satisfactory and the interim reports are technically deficient. As a result, the Energy Commission staff terminated the agreement at the August 2017 Business Meeting.
EPC-14-035 Demonstration of integrated photovoltaic systems and smart inverter functionality utilizing advanced distribution sensors	Pre-existing intellectual property identified in agreement EPC-14-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Lawrence Berkeley National Laboratory	Group 4: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The project advanced the state of technology by introducing a smart inverter with an embedded synchrophasor that is scalable across investor-owned utility territory, enabling well-coordinated and managed high-density PV installations. The technology is particularly interesting to PV inverter manufacturers and system integrators of combined PV and battery storage systems. The information delivered by this technology informs inverter settings, in accordance with California Rule 21, with the overall objective to improve the reliability of the electrical grid.	1e, 2a, 3c, 3d, 3f, 4a, 5b	The project team built a central infrastructure and models for power systems study, mitigation strategies and control schemes. This project is pushing the state of the art by developing a new controller architecture based on model predictive control (MPC) methods to provide optimal control of the entire system of battery storage, PV, and the building load, subject to a variety of power constraints, with the objective of minimizing the total energy cost for the customer. The results of this project are multifold and well aligned with the overall objective of enabling large renewable generation on the electrical power grid. The controller was field tested and improved over the course of 3 months. The team published the developed tools and models on four public repositories on GitHub; and presented project findings, and results at two technical conferences.
EPC-14-036 Smart Inverter Interoperability Standards and Open Testing Framework to Support High-Penetration Distributed Photovoltaics and Storage	Pre-existing intellectual property identified in agreement EPC-14-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	SunSpec Alliance	Group 3; Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project team developed smart inverter testing scripts for CA Rule 21 Phase 1 compliance. Testing proved that smart inverters made by different manufacturers perform CA Rule 21 Phase 1 autonomous functions in a manner consistent with the UL 1741 SA standard, thus increasing interoperability across PV system configurations and expanding customer choice. Project results showed that smart inverters compliant with CA Rule 21 Phase 1 requirements can be installed safely. Knowledge gained from the project informed the development of the Common Smart Inverter Profile that forms the basis of CA Rule 21 Phase 2 compliance.	1b, 3d, 3f, 4a, 5b	The project developed, demonstrated, and evaluated CA Rule 21 Phase 1 and Phase 2 new smart-inverter standards that enable high photovoltaic penetration at penetration levels of 100 percent or more while simultaneously eliminating reverse energy flow and mitigating thermal problems associated with non-smart inverters. Financial analysis of using smart inverters showed annual saving of $640 million to $1.4 billion. The knowledge gained from the project is available to inverter and DER manufacturers, aggregators, end users, utilities, regulatory agencies, and other members of the public via SunSpec Alliance distribution channels including its website, newsletters, educational events, media outreach, and promotional events with the goal of promoting how open communication standards can positively impact the grid.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-037 Home Energy Efficiency Retrofits in California: An Analysis of Sociocultural Factors Influencing Customer Adoption	Market Facilitation	This project conducted a multidisciplinary, data driven study to understand the role and interactions of various factors influencing the adoption and utilization of residential energy efficiency measures. The study provided awareness into the stand alone and interactive effects of factors such as income, ethnicity, language, and political orientation on the adoption of energy efficient technologies, with a primary focus on the Latino population in the Fresno area. Knowledge gained from this study can be used to enhance energy policy and program design to account for social, cultural, and behavioral factors.	4/8/2015	No	Demand-side Management	$599,924	$599,924	$570,017	N/A	$570,017	$166,993	$0	Renovate America	$214,000	26.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-038 Fieldwork to Document Technology Adoption and Behavior Change Across Diverse Geographies and Populations to Inform Energy Efficiency Program Design	Market Facilitation	This project uses empirical research methods grounded in anthropology and other social and behavioral sciences to explore the factors affecting behavior beyond simple economic rationale. This practice is achieved by documenting and analyzing emerging attitudes, emotions, experience, habits, and practices around technology adoption for purposes of devising predictive indicators for on-going potential studies regarding energy consumption in California.	4/8/2015	No	Demand-side Management	$574,545	$574,545	$573,944	N/A	$573,944	$40,208	$0	Indicia Consulting; California State University San Marcos	$52,500	8.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-039 Cultural Factors in the Energy Use Patterns of Multifamily Tenants	Market Facilitation	This project examined the cultural and demographic factors that correlate with multifamily tenants' electric energy use patterns, before and after energy efficiency upgrades, and tenant engagement activities. Using multilevel tenant surveys and interval meter data analytics this study investigated the who, what, and why variations in multifamily energy use patterns. The large data sets will help to improve demand forecasts and energy efficiency program design by providing lessons learned and guidance for how social, cultural, and socioeconomic groups use energy differently in multifamily settings.	4/8/2015	No	Demand-side Management	$379,019	$379,019	$368,358	N/A	$368,358	$107,714	$0	Pacific Gas and Electric Company	$100,000	20.9%	Grant

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EPC-14-037 Home Energy Efficiency Retrofits in California: An Analysis of Sociocultural Factors Influencing Customer Adoption	Pre-existing intellectual property identified in agreement EPC-14-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	Center for Sustainable Energy	Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of the Hispanic subpopulation that discourage or prevent their participation.	2a, 5c	CSE's analysis of 704 records sample revealed that using brochures with imagery of modest houses and families that appeared Hispanic (as opposed to imagery of large homes and non-Hispanic, Caucasian families) had a positive impact on sign-up rates in census tracts with a high concentration of Hispanics. Despite this increased number of sign-ups, phone interviews with 30 self-identified Hispanic participants found few had completed or planned major upgrades based on the energy audit recommendations, though minor upgrades like weather-stripping or light bulb replacements were more common. These results highlight the importance of tailoring outreach materials for energy efficiency programs, and the efficiency potential that can be accessed through improved program outreach.
EPC-14-038 Fieldwork to Document Technology Adoption and Behavior Change Across Diverse Geographies and Populations to Inform Energy Efficiency Program Design	Pre-existing intellectual property identified in agreement EPC-14-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	Indicia Consulting	Ranked # 5	N/A	N/A	No	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project will help increase customer participation in utility efficiency programs by better understanding the social, cultural and behavior aspects of various subpopulations that discourage or prevent their participation.	1f, 1h, 5c	This project investigated the engagement of households with personal consumer electronics (e.g. smartphones, tablets, laptops) in two utility territories in California. Through extensive analysis of interview data, the research team identified a psycho-social characteristic termed "cybersensitivity". Cybersensitives are people who appear to exhibit a greater emotional connection to their phones, tablets, and other personal technology. The research team found that the sample groups segmented according to differentiated behaviors and attitudes related to engagement with devices and attitudes around electricity consumption and conservation. The research team recommend that utilities and other policy-makers, who are seeking larger energy savings, begin by targeting Cybersensitives for participation in feedback programs, using opt-in program design. The Final Report has been received.
EPC-14-039 Cultural Factors in the Energy Use Patterns of Multifamily Tenants	Pre-existing intellectual property identified in agreement EPC-14-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 12 bidders	TRC Engineers, Inc.	Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (De Leon, 2015) sets energy efficiency targets for 2030 and allows for the targets to be achieved, in part, from utility programs that provide financial incentives and rebates to their customers to increase energy efficiency. This project provides program developers information on how social, cultural, and behavior aspects of multi-family building tenants impact participation in utility efficiency programs. The findings in the survey will help design utility efficiency programs to better engage customers in multifamily units to increase participation and achieve greater energy savings.	2a, 5c	This project was completed in December 2017. The project surveyed energy use in multi-family units in the Bay Area and the Central Valley. The project found that the differences between load profiles are also correlated with demographic and cultural factors such as race/ethnicity of the occupants as well as the amount of plug loads they use. These are second order effects though to the weather-dependent energy use such as use of cooling energy in the hot Central Valley versus relatively mild coastal areas. The multivariate analysis shows that no single demographic or cultural factor (nor interactions with others) by themselves explain the differences more than or as much as the effects of location and climate. The initial finding of the TRC survey were presented at the BECC Conference on October 17, 2017 in Sacramento, CA.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-040 Self-Tracking Concentrator Photovoltaics for Distributed Generation	Applied Research and Development	This research project developed, tested, and demonstrated a self-tracking concentrator photovoltaic (ST-CPV) system -- a new concentrator photovoltaic technology that does not require a precision mechanical tracker to keep it aligned to the sun. The ST-CPV panel contains a thin layer of fluids that passively respond to the changing solar angle, automatically adjusting optical pathways within the device to ensure that incident sunlight is captured and concentrated over a wide range of angles. The passive internal tracking allows ST-CPV panels to be mounted in a stationary configuration or with a simple single axis tracker. This makes the system highly economical, greatly reduces installation and maintenance complexity, and enables distributed generation with higher efficiency CPV modules.	5/13/2015	No	Generation	$999,940	$999,940	$999,939	N/A	$999,939	$282,545	$200,000	United States Department of Energy; U.S. Department of Energy	$2,500,000	71.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-041 Installation of a Lean Burn Biogas Engine with Emissions Control to Comply with Rule 1110.2 at a Wastewater Treatment Plant in South Coast Air Quality Management District	Technology Demonstration and Deployment	This project aimed to design, build and install a continuously operating commercial scale emissions reduction system for the lean burn biogas engine(s) at a municipal wastewater treatment plant in Palm Springs California. If successful, the project would have enable lean burn biogas engines to comply with existing and future air quality regulations when deployed at wastewater treatment plants, resulting in reduced flaring and net reductions in emissions.	4/8/2015	No	Generation	$2,249,322	$2,249,322	$11,858	N/A	$11,858	$0	$0	Anaergia Technologies, LLC	$450,000	16.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-044 Enabling Anaerobic Digestion Deployment for Municipal Solid Waste-to-Energy	Technology Demonstration and Deployment	The purpose of this project is to enable environmentally and economically sustainable deployment of technology that transforms organic municipal solid waste into heat, electricity, and compost via dry anaerobic digestion. A dry anaerobic digestion and composting facility processing the organic fraction of MSW has been scaled up from 40,000 tons/year to 90,000 tons/year to increase production of renewable electricity and heat.	4/8/2015	No	Generation	$4,300,000	$4,300,000	$4,300,000	N/A	$4,300,000	$1,497,504	$0	Zero Waste Energy Development Company	$1,500,000	25.9%	Grant

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EPC-14-040 Self-Tracking Concentrator Photovoltaics for Distributed Generation	Pre-existing intellectual property identified in agreement EPC-14-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Glint Photonics, Inc.	Group 4: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The project team estimates that 50% of rooftops would be appropriate for ST-CPV systems in California, where the average direct solar resource is 78% or more of the total solar resource. The successful development of this technology will bring significant manufacturing employment opportunities to California. Unlike conventional PV modules, ST-CPV modules are well-suited to local manufacturing because they do not benefit significantly from colocation with the semiconductor foundry. CPV cell technology is an area where U.S. manufacturers have a substantial technical advantage over foreign competitors. An additional benefit conferred by this technology is an improved energy solution for remote off-grid communities. Many of such communities are located in desert areas of California that are particularly well-suited to the use of ST-CPV panels as a result of the high direct solar resource.	1a, 4a	The project team built and tested the three generations of prototypes, and all met or exceeded their target performance. In extended outdoor testing, the final prototype provided consistent performance and demonstrated a peak electrical conversion efficiency of 22.5 percent, similar to the top performing silicon modules. The cost model for the CPV modules estimated a cell cost of $1/cm2 in large volume. The novel optical and mechanical architecture developed in this program also has useful application in the lighting field. Glint has spun off two new research projects from this work to provide novel adjustable high-efficiency lighting fixtures. Both of these projects offer substantial energy savings impact, and have strong commercial opportunities due to the design and functionality benefits they offer. Final Report is in review for publication.
EPC-14-041 Installation of a Lean Burn Biogas Engine with Emissions Control to Comply with Rule 1110.2 at a Wastewater Treatment Plant in South Coast Air Quality Management District	Pre-existing intellectual property identified in agreement EPC-14-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Biogas & Electric, LLC	Group 3: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	The technology that was to be demonstrated was a low cost NOx and SOx reduction wet scrubbing technology called NOxRx (a registered trademark) which can be used in conjunction with all biogas engines and anaerobic digesters in the market today. NOxRx has a patented method of utilizing the effluent stream from an anaerobic digester to reduce emissions from biogas engines. Unlike SCR, it does not produce N2O and does not require H2S removal or biogas conditioning prior to combustion. Therefore, NOxRx represents a significant cost savings over competing NOx reduction solutions. The goal of this project was to demonstrate the commercial viability of NOxRx for biogas-fired lean burn engines to comply with CARB NOx and SOx standards, and SCAQMD Rule 1110.2.	1a, 1c, 1f, 3a, 3b, 4b, 4e	Biogas & Electric was unable to demonstrate its emission reduction system at the Palm Springs and the project termed-out.
EPC-14-044 Enabling Anaerobic Digestion Deployment for Municipal Solid Waste-to-Energy	Pre-existing intellectual property identified in agreement EPC-14-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 6	N/A	N/A	Yes; Calif Based Entity	This project provides valuable insight to identify optimum pathways that overcome barriers for large-scale deployment of biomass conversion technologies. The research has focused on overcoming barriers for urban stakeholders, including odor, access to the utility grid, and improved utilization of waste heat.	2a, 3g, 4a	The project team measured NOx emissions during several flaring events to establish primary NOx formation pathways, which may include thermal, fuel, and prompt NOx formation. The team performed air emission measurements and modeling to minimize odors and greenhouse gases from anaerobic digestion and the composting facility. The project team has also updated a Life Cycle Assessment model to identify opportunities for improved economic and environmental performance by quantifying the life-cycle cost, energy demand, and the greenhouse gas impacts of the existing ZWEDC facility and paths to scale-up. ZWEDC has interconnected to PG&E grid and enrolled in CAISO to enable sale of net electricity. This project was completed in March, 2019.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-045 Advanced Recycling to 1-MW Municipal Solid Waste of Electricity Generation	Applied Research and Development	This project designs, develops and tests a waste-to-energy Process Development Unit (PDU), involving conversion of Refuse Derived Biomass into clean fuel gas by thermal-catalytic gasification, reforming, and pulse detonation technology. This is a two-stage process, with a primary gasification stage, followed by a reforming stage; and hot filtration, followed by wet scrubbing of the process gas. This project tests a 3-pound per minute PDU, evaluates the results, and provides engineering data to design a 30 ton/day plant generating 1-MW electric power.	4/8/2015	No	Generation	$1,499,481	$1,499,481	$1,499,480	N/A	$1,499,480	$168,742	$0	Taylor Energy	$46,616	3.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-046 Lowering Food-Waste Co-digestion Costs through an Innovative Combination of a Pre-Sorting Technique and a Strategy for Cake Solids Reduction	Technology Demonstration and Deployment	The project demonstrated two complementary approaches to lower the overall cost of co-digestion: a new technology to lower preprocessing cost of food wastes, and a new strategy to lower the mass of cake solids requiring disposal. The new technology for the preprocessing of food wastes uses an organic waste preprocessing technique known as an organic extrusion press (OEP) for selective extrusion of organic materials and is capable of recovering 95% of organics. The project applies a new strategy in operating co-digestion systems that involves optimizing the organic waste loading in a way that will lower the mass of cake solids requiring disposal relative to the conventional process.	4/8/2015	No	Generation	$1,496,902	$1,496,902	$1,382,677	N/A	$1,382,677	$323,906	$0	Silicon Valley Clean Water (SVCW); Water Environment & Reuse Foundation	$2,630,000	63.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-047 Dairy Waste-to-Bioenergy via the Integration of Concentrating Solar Power and a High Temperature Conversion Process	Applied Research and Development	The goal of the project is to integrate Concentrating Solar Power (CSP) and Hydrothermal Processing (HTP) into a single, integrated system; confirm that it can convert dairy manure into renewable natural gas (RNG) and bio-crude; study the economics of integrated CSP-HTP systems sited at dairy farms; and confirm that the RNG produced meets pipeline-transmission and geological-storage quality standards. The project seeks to prove that it is possible to store the energy contained in dairy manure waste in a manner that enables California natural gas plants to produce readily dispatchable, ultra-low-emissions renewable electricity.	4/8/2015	No	Generation	$1,494,736	$1,494,736	$1,490,418	N/A	$1,490,418	$96,773	$0	Southern California Gas Company (SoCalGas)	$600,000	28.6%	Grant

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EPC-14-045 Advanced Recycling to 1-MW Municipal Solid Waste of Electricity Generation	Pre-existing intellectual property identified in agreement EPC-14-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Taylor Energy	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project researches, develops, and verifies thermal catalytic gasification technology that will overcome technical and economic barriers preventing the use of refuse derived biomass (RDB) as an energy resource in California. Completion of the current gasification/reforming test program enables future scale-up to 30-ton/day RDB-to-energy (1-MWe scale), in preparation for commercial scale design at 300-ton/day, generating 10-MW of electricity with costs of less than $3,750/kWh of installed capacity.	2a, 4a, 4e	Design, fabrication and installation of the major equipment, consisting of Process Development Unit, reformer, gas-flare and gas conditioning, at the host site was completed. Testing of the gasification system was completed. Initial startup of the gasification was performed using 8 lbs. of wood pellets, and then refuse derived biomass. The rate of char conversion was increased to 9.47% by operating pulse burner at 900 degrees C and a modification to the gasifier that allows char particles to stay longer in the gasification zone. This modification also resulted in increased syngas production. The Levelized Cost of Electricity was estimated at $118/MWh for 10-MW scale compared to grid supplier power that will likely average $150/MWh through 2024. This project was completed in March, 2019. The gasifier technology is now being refined and upgraded for future commercialization.
EPC-14-046 Lowering Food-Waste Co-digestion Costs through an Innovative Combination of a Pre-Sorting Technique and a Strategy for Cake Solids Reduction	Pre-existing intellectual property identified in agreement EPC-14-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Kennedy/Jenks Consultants	Group 3: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	This project developed a reliable and cost-effective bioenergy from wastewater treatment plants (WWTP) through the integration of an organic waste preprocessing technique known as organic extrusion press and co-digestion of locally available food waste and restaurant fats, oil, and grease (FOG) in an optimized manner that lowers the mass of cake solids that needs disposal. Though there is some seasonal variation, the supply of wastewater, food waste and FOG are very reliable.	3a, 4a, 4e	Project successfully demonstrated two complementary approaches to lower the overall cost of co-digestion: a new technology to lower preprocessing cost of food wastes (FW), and a new strategy for the addition of Fats, Oil, Grease (FOG) or FW to lower the mass of cake solids requiring disposal. The technology uses an organic waste separation technique known as an organic extrusion press (OEP/OREX) for selective extrusion of organic materials that has a higher efficiency than conventional techniques. Also, the technology is more economical than typical source separation programs since it requires minimal preprocessing. Results indicated 54% savings compared to source separation and polishing of FW currently practiced. Economic evaluation of a 100 MGD plant indicated $8.9 to $9.3 million worth of energy savings by energy recovery, due to increased gas production.
EPC-14-047 Dairy Waste-to-Bioenergy via the Integration of Concentrating Solar Power and a High Temperature Conversion Process	Pre-existing intellectual property identified in agreement EPC-14-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Southern California Gas Company (SoCalGas)	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will develop and demonstrate a new bioenergy pathway which utilizes hydrothermal processing and concentrating solar power to convert dairy manure into bio-crude and renewable natural gas that will enable dispatchable and low emissions renewable electricity.	1a, 1i, 2a, 3g, 4a, 4b, 4e	Redesign of the CSP receiver was completed by the National Renewable Energy Laboratory (NREL), resulting in fabrication of the receiver in 2017. Design and fabrication of the Genifuel hydrothermal processing (HTP) unit was completed with input from the Pacific Northwest National Laboratories (PNNL). Construction of the HTP system was completed and the Hyperlight CSP facility was expanded to a half acre in size using redesigned collectors and receivers. The HTP system was commissioned and testing was completed after integration with the Hyperlight system. This is the first project where CSP and HTP technologies have been integrated. This project was completed in March, 2019. Southern California Gas Company is planning to use HTP system in the future for other projects.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-050 City of Fremont Fire Stations Microgrid Project	Technology Demonstration and Deployment	The project team designed and built microgrids at three fire stations in Fremont, California. Each microgrid consists of a microgrid energy management system, a parking lot canopy photovoltaic system, and a battery energy storage system. The automated microgrid control system manages local energy resources and loads. The microgrids are designed to provide at least three hours a day of power for critical loads during a utility power outage.	4/8/2015	No	Distribution	$1,817,925	$1,817,925	$1,817,671	N/A	$1,817,671	$73,475	$0	City of Fremont; Gridscape Solutions, Inc.; Delta Products Corporation; Microgrid Energy	$657,260	26.6%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	Applied Research and Development	This project aims to design, deploy, and test a 150 kilowatt-electric (kWe) modular, mobile biomass gasification generator (the Powertainer) that converts forest slash biomass into on-demand renewable energy that meets the California Air Emission Standards. The results of the demonstration will inform the optimal siting of such systems to enhance grid stability and the impact of monetizing current forest waste as fuel on forest thinning, hydrological resources, and wildfire risk.	4/8/2015	No	Generation	$1,990,071	$1,990,071	$1,881,963	N/A	$1,881,963	$311,727	$225,000	All Power Labs, Inc.	$686,038	26.6%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	Applied Research and Development	This project aims to design, deploy, and test a 150 kilowatt-electric (kWe) modular, mobile biomass gasification generator (the Powertainer) that converts forest slash biomass into on-demand renewable energy that meets the California Air Emission Standards. The results of the demonstration will inform the optimal siting of such systems to enhance grid stability and the impact of monetizing current forest waste as fuel on forest thinning, hydrological resources, and wildfire risk.	4/8/2015	No	Generation	-$99,946	-$99,946	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant

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EPC-14-050 City of Fremont Fire Stations Microgrid Project	Pre-existing intellectual property identified in agreement EPC-14-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Gridscape Solutions, Inc.	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity, Minority Owned	Critical facilities, such as fire stations, are vulnerable to power outages, so having local, renewable generation decreases their dependence on outside electricity sources. This is the first implementation of microgrids for several fire stations in the region and creates a great opportunity for proof of concept to overcome risk and knowledge barriers to adopting high penetration solar PV systems and energy storage, demonstrate energy efficiency by optimizing power generation and loads, and provide increased energy security during utility power outages. The microgrids help reduce grid congestion and increase grid reliability.	1e, 1h, 4a, 5a	Gridscape Solutions successfully completed the microgrid project in March 2019. Because of the widespread awareness of the public safety power shutoff, these microgrids at Fremont fire stations received a lot of interest, and were featured in several news articles and reports. Gridscape Solutions is expecting to have more than 25 microgrids designed and deployed by the end of 2020. The final report, Solar Emergency Microgrids for Fremont Fire Stations - Demonstrating Energy Savings and Grid Resilience for Critical Facilities has been published.
EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	Pre-existing intellectual property identified in agreement EPC-14-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	All Power Labs, Inc.	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project develops and demonstrates a high-capacity, mobile conversion system capable of cost-effectively converting forest biomass near where it is sourced into renewable, on-demand energy to help address a myriad of issues associated with climate change, including drought, fires, and the need for more renewable energy.	1a, 1c, 4a	The 150-kW Powertainer (PT) demonstrated how a containerized and portable gasification system could address the tree mortality crisis by converting forestry waste into clean, renewable energy and sequestering carbon at locations that can best utilize available fuel. During the 40 hours of performance testing, the technology met the majority of the performance targets set in the testing plan; however, the PT was not able to reach the expected electrical output of 150 kW during this test period. The system achieved 100 kW at maximum power with stable power production at 50 kW. The PT progressed from a technology readiness level of 4 to 6. The next generation of the Powertainer is targeted to advance the TRL to a commercial readiness level.
EPC-14-051 Cleaner Air, Cleaner Energy: Converting Forest Fire Management Waste to On Demand Renewable Energy	Pre-existing intellectual property identified in agreement EPC-14-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	All Power Labs, Inc.	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project develops and demonstrates a high-capacity, mobile conversion system capable of cost-effectively converting forest biomass near where it is sourced into renewable, on-demand energy to help address a myriad of issues associated with climate change, including drought, fires, and the need for more renewable energy.	1a, 1c, 4a	The 150-kW Powertainer (PT) demonstrated how a containerized and portable gasification system could address the tree mortality crisis by converting forestry waste into clean, renewable energy and sequestering carbon at locations that can best utilize available fuel. During the 40 hours of performance testing, the technology met the majority of the performance targets set in the testing plan; however, the PT was not able to reach the expected electrical output of 150 kW during this test period. The system achieved 100 kW at maximum power with stable power production at 50 kW. The PT progressed from a technology readiness level of 4 to 6. The next generation of the Powertainer is targeted to advance the TRL to a commercial readiness level.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-052 Community Scale Digester with Advanced Interconnection to the Electrical Grid	Technology Demonstration and Deployment	The project's aim is to install and operate an innovative anaerobic digestion system using a high-rate biodigester technology that will process approximately 50 tons per day (TPD) of organic waste from a large supermarket (Albertsons) distribution center and 50 TPD (20,000 gallons) of high-strength slurry created by recovering and concentrating organics in wastewater streams. This project is co-located with the Co-West Commodities Wastewater Pre-Treatment Facility - an operation that collects wastewater (carbs, sugar, protein, and fat, grease, and oil) from industrial businesses and pre-treats the material for disposal into the local sewer system.	4/8/2015	No	Generation	$5,000,000	$5,000,000	$4,303,553	N/A	$4,303,553	$252,977	$0	CleanWorld; Organic Energy Solutions	$7,772,939	60.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-053 A Renewable Based Direct Current Building Scale Microgrid	Technology Demonstration and Deployment	The team developed a DC microgrid that connects on-site generation directly with loads and provides a low cost, energy-efficient solution for warehouse facilities. Solar PV is directly connected to energy-efficient DC lighting, a DC energy storage system, and ventilation to form a DC building microgrid.	4/8/2015	No	Distribution	$2,817,566	$2,817,566	$2,389,216	N/A	$2,389,216	$276,825	$0	Maxwell Technologies; AMERICAN HONDA MOTOR COMPANY, INC.; Robert Bosch LLC; Regents of the University of California, Davis - California Lighting Technology Center; Imergy Power Systems	$1,797,544	38.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-054 Demonstrating a renewable based microgrid for a critical facility at the Blue Lake Rancheria	Technology Demonstration and Deployment	This project team developed and demonstrated a microgrid at an American Red Cross evacuation center. The microgrid included renewables and energy storage to bolster the resiliency of this critical support facility and the capability of the microgrid to power itself with a high penetration of local renewable resources.	6/10/2015	No	Distribution	$5,000,000	$5,000,000	$5,000,000	N/A	$5,000,000	$832,908	$0	Humboldt State University Foundation, Schatz Energy Research Center; Pacific Gas and Electric Company; Siemens Energy and Automation, Inc.; Tesla, Inc.; Serraga Energy, LLC at Blue Lake Rancheria; GHD, Inc.	$1,318,422	20.9%	Grant

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EPC-14-052 Community Scale Digester with Advanced Interconnection to the Electrical Grid	Pre-existing intellectual property identified in agreement EPC-14-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 23 bidders	Organic Energy Solutions	Group 3: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The project will demonstrate the use of electrical generation powered by digester gas to provide reliable power to a critical facility during outages on the grid. The electricity from this project will be exported to the SoCal Edison distribution grid through a SB 1122 Bioenergy Feed-in Tariff. The system will also be equipped with islanding capability to support the critical facility during an interruption in the grid.	1b, 1c, 2a	The project experienced delays in interconnection and permitting processes. As a result, the grantee was not be able to complete the installation and testing within the previously-extended agreement term. CEC granted a time extension through March, 2020 to be funded at the recipient's expense. Construction is underway and nearing completion. Project outcomes will be reported to the CEC in March, 2020.
EPC-14-053 A Renewable Based Direct Current Building Scale Microgrid	Pre-existing intellectual property identified in agreement EPC-14-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Robert Bosch LLC	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project demonstrated the feasibility and benefits of a commercial-scale DC building microgrid that uses multiple DC technologies to provide reliable power to the loads on DC circuits, resilience during grid outages, increased energy efficiency and renewable energy utilization with lower losses. Additionally, the project team was able to obtain Title 24 approval for their DC design and an interconnection agreement with the local utility. Both steps were first of a kind approvals for a facility such as the large automotive distribution facility used for the demonstration.	1e, 1h, 4a, 5a, 5d	The project is complete and the final report is in the publication process. The microgrid, operated by a Bosch microgrid controller system, reduced the need for inverters for PV and rectification equipment for the loads. The microgrid improved the overall utilization of solar energy by roughly 7-10% as compared to conventional AC systems, while lowering component complexity and costs.
EPC-14-054 Demonstrating a renewable based microgrid for a critical facility at the Blue Lake Rancheria	Pre-existing intellectual property identified in agreement EPC-14-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Humboldt State University Sponsored Programs Foundation	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project advanced microgrid technology by demonstrating a new microgrid controller and integrating a set of equipment that had not previously been combined in a microgrid setting. The project demonstrated the ability to integrate solar electric power with battery energy storage, conventional generators, and dispatchable demand into a microgrid to support a certified American Red Cross shelter, with an added benefit of relegating the existing fossil fueled generators to a deep backup role where they rarely run. A microgrid control system was successfully implemented using protection relays to provide safe and reliable microgrid operation. It was able to perform automated transitions from grid connected to islanded states in response to the state of the area electric power system.	1e, 1h, 4a, 5a, 5d	The project was completed in March 2018. The Blue Lake Rancheria renewable microgrid has demonstrated a robust, renewable-based microgrid system that provides costs savings for the facility during normal operation and successfully islanded during a grid outage. As a result of knowledge transfer and outreach activities, the microgrid project received the Federal Emergency Management Agency's 2017 Whole Community Preparedness Award and POWERGRID International's Project of the Year (2018) award for Distributed Energy Resource Integration, marking the first time that a non-utility won the award. The final report is available at: https://www.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf, https://www.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-055 Las Positas College Microgrid	Technology Demonstration and Deployment	This project demonstrated the creation of an inexpensive microgrid to optimize distributed energy sources and uses for a campus by adding energy storage and advanced energy management tools and integrating them with legacy photovoltaics to form a community college microgrid.	4/8/2015	No	Distribution	$1,522,591	$1,522,591	$1,431,911	N/A	$1,431,911	$260,719	$0	Chabot-Las Positas Community College District	$450,000	22.8%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-056 Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid	Technology Demonstration and Deployment	This project installed PEV charging equipment in five sites in Santa Monica to demonstrate scenarios that represented new power needs, including smart charging, peak shaving, load management, and load smoothing while improving power quality and grid stability. The selected sites reflected a variety of scenarios including public charging, fleet charging, integration of solar generation with charging, and integration of energy storage with fast charging. Further, the project assessed the usefulness of vehicle to grid and vehicle to building technologies for allowing bi-directional energy flow and using PEVs as distributed energy storage. The project objective was to provide a model (using simulations to predict grid behavior and emulations using real-world power flows) that could be used by fleet owners or building owners for grid planning, pricing, and incentive decisions.	4/8/2015	No	Demand-side Management	$1,989,432	$1,989,432	$1,844,906	N/A	$1,844,906	$358,770	$500,000	City of Santa Monica; The Regents of the University of California, Los Angeles; Korea Institute of Energy Research (KIER); California Lithium Battery; Proximetry	$500,000	20.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-057 Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets	Technology Demonstration and Deployment	This project developed and demonstrated a managed charging system applied to more than 25 Alameda County fleet electric vehicles and charging stations. The researchers also developed approaches to engage non-fleet electric vehicle owners who charge their vehicles at Alameda County's publicly available charging stations and managed their charging station loads to further reduce utility costs. Although the project focused on one-way (uni-directional) charging, the approach is compatible with future vehicles and chargers that may have two-way (bi-directional) charging capability. The research had three main technical tasks: Task 1 - Characterize site and fleet, collect charging session and meter data, and analyze data for control strategies; Task 2 - Implement and demonstrate fleet and public electric vehicles managed charging control system; Task 3 - Quantify the potential of fleet and non-fleet electric vehicles in the managed charging system as demand response capabilities in the retail and wholesale electricity markets.	4/8/2015	No	Demand-side Management	$1,993,355	$1,993,355	$1,794,690	N/A	$1,794,690	$812,829	$0	Bay Area Climate Collaborative; The Regents of the University of California, Berkeley; Kisensum; ChargePoint, Inc.; County of Alameda, General Services Agency	$536,761	21.2%	Grant

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EPC-14-055 Las Positas College Microgrid	Pre-existing intellectual property identified in agreement EPC-14-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Chabot-Las Positas Community College District	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The project identified and measured the benefits of microgrids for customers to shift peak energy use to coincide with peak solar production and reduce peak demands by demonstrating the capability of microgrids made from a mix of new and legacy equipment. This project measured the microgrid's benefits by using existing retail utility rates as well as simulating a demand response market.	1e, 1h, 4a, 5a, 5d	The project team completed the microgrid in March 2019. A final report titled "Making a Microgrid from Legacy Systems - Las Positas Microgrid" was posted and is available.
EPC-14-056 Demonstrating Plug-in Electric Vehicles Smart Charging and Storage Supporting the Grid	Pre-existing intellectual property identified in agreement EPC-14-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Regents of the University of California, Los Angeles	Group 3: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	Most current electric vehicle service equipment (EVSE) provide uncontrolled charging without using smart algorithms, software, or standard network technologies. This project demonstrated a pre-commercial PEV infrastructure that used a control center, communicating over a wireless communication network, to control the charging operations of the EVSEs using smart charging algorithms. The pre-commercial infrastructure (WINSmartEV TM) developed by UCLA was advanced so that it is able to determine optimized charging and/or vehicle to grid services based on PEV profiles, user preferences, grid-related events, and grid capacities.	1h, 3f, 4b	The final report was published in August 2018: http://www.energy.ca.gov/2018publications/CEC-500-2018-020/CEC-500-2018-020.pdf. The research demonstrated that large numbers of PEVs can be managed for the benefit of the PEV and facility owners. The recipient successfully developed a system, utilizing existing charging infrastructure and without adding large amounts of power capacity, that could control and balance charging through scheduling algorithms that met the needs of the PEV and facility owners. The recipient also demonstrated how the system can be used by facility (e.g., garage) owners to save money through demand charge reduction and demand response, while supporting their employees or customers.
EPC-14-057 Smart Charging of Plug-in Vehicles with Driver Engagement for Demand Management and Participation in Electricity Markets	Pre-existing intellectual property identified in agreement EPC-14-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project developed an aggregation system for smart charging PEV vehicles to provide demand response, mitigate demand charges, and leverage time of use rates. A charging control system was applied to a fleet of vehicles owned by Alameda County and to charging stations that are used by both county vehicles and the public. The project added systems for intelligent prediction of PEV loads and control algorithms to create a flexible, modular, and scalable solution for smart charging county fleet and public PEVs. The managed charging control system will enable growth in PEV adoption without straining current grid infrastructure. These approaches can also be applied to commercial and workplace charging and provide large benefits in managing peak electricity demand across California by helping consumers reduce or shift their electricity use during times when electricity demand is high.	1g, 1h, 2a, 3f, 4a, 4b, 5b	The project successfully demonstrated a set of smart charging strategies at an Alameda County parking garage. Highlights include development of separate smart charging system platforms to meet the different requirements of each application (i.e., fleet vehicles, public vehicles, and the direct current fast charger); recruitment of public charging users to participate; public PEV managed charging to achieve utility bill savings by managing peak demand; and quantification of the potential of the fleet PEV managed charging system for multiple demand response products in California electricity markets. As a result of this project, LBNL was able to further build out the MyFleetBuy tool to help fleet owners incorporate PEVs into their fleet. LBNL is working with Alameda, Oakland, and Caltrans to help facilitate PEV smart charging technologies into their large-scale fleet procurement processes.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-059 Laguna Wastewater Treatment Plant Microgrid	Technology Demonstration and Deployment	This project upgraded a wastewater treatment plant to use a microgrid with a solar photovoltaic system, energy storage, and a microgrid controller for increased resiliency and to participate in energy markets.	4/8/2015	No	Distribution	$4,999,804	$4,999,804	$4,983,459	N/A	$4,983,459	$187,080	$0	City of Santa Rosa; Parker Hannifin Corp; Nuvation Engineering	$2,290,000	31.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-060 Demonstrate a utility-owned renewable based community microgrid at Borrego Springs California	Technology Demonstration and Deployment	SDG&E and the project team demonstrated a utility-owned renewable based community microgrid at Borrego Springs California. The renewable based microgrid is able to island the entire community with a peak load of approximately 14 MW, serving approximately 2,500 residential and 300 commercial and industrial customers. The SDG&E microgrid utilizes a 26 MW PV system, two substation batteries, three distributed batteries and an ultracapacitor.	4/8/2015	No	Distribution	$4,724,802	$4,724,802	$4,454,034	N/A	$4,454,034	$923,165	$0	San Diego Gas & Electric Company; SMA America; OSISoft, LLC	$1,739,560	26.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-061 Learning from Real-World Experience to Understand Renewable Energy Impacts to Wildlife	Applied Research and Development	This research used real-world data to understand renewable energy impacts to wildlife. The researchers analyzed data on wildlife fatalities and habitat loss to determine the significance of fatalities to population persistence; compared pre-construction predicted and post-construction actual impacts (fatalities) to sensitive species, as a foundation for improving predictive accuracy; and compared predicted and actual benefits of mitigation to sensitive species, as a foundation for improving predictive accuracy. The research goal was to gain a better understanding of the actual environmental impacts of renewable energy generation for wildlife. The information gathered through this process can then be used by land and wildlife managers and permitting and regulatory agencies to reduce those environmental impacts, thus lowering financial and environmental costs from energy generation.	6/10/2015	No	Generation	$1,000,000	$1,000,000	$978,402	N/A	$978,402	$262,924	$400,000	US Geological Survey; University of Maryland Center for Environmental Studies Appalachian Laboratory; NextEra Energy	$1,617,177	61.8%	Grant

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EPC-14-059 Laguna Wastewater Treatment Plant Microgrid	Pre-existing intellectual property identified in agreement EPC-14-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Trane U.S., Inc.	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project demonstrated that a microgrid at a wastewater treatment plant can operate without compromising water quality or negatively affecting plant operations. The EPIC funds demonstrated a functional microgrid by integrating energy storage, on-site generation, and control components and improved resilience.	1e, 1h, 4a, 5a, 5d	The project team completed the project in March 2019, which demonstrated a successful microgrid for a waster water treatment plan.
EPC-14-060 Demonstrate a utility-owned renewable based community microgrid at Borrego Springs California	Pre-existing intellectual property identified in agreement EPC-14-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	San Diego Gas & Electric Company	Group 2: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The project demonstrated improved grid resiliency from using a high penetration renewable based microgrid. There was an immediate benefit to the Borrego Springs community of non-interrupted energy resources during power outages. The microgrid controller was also able to make greater use of the large local solar plant's renewable energy while avoiding adverse grid impacts by coordinating the operation of the various energy storage units with the solar energy output.	1e, 1h, 4a, 5a, 5d	The project was completed in July 2018. The Borrego Springs Microgrid project demonstrated a robust, renewable-based system that provides critical power during emergencies and planned outages, which are necessary when system upgrades and maintenance work are needed. Unlike behind the meter microgrids, the Borrego Springs Microgrid is the first true community microgrid for an entire city and not just for a single metered customer. A unique aspect of this microgrid is that the microgrid assets are located throughout the community where they are able to provide the greatest support. The final report is available at: https://www.energy.ca.gov/2019publications/CEC-500-2019-011/CEC-500-2019-011.pdf.
EPC-14-061 Learning from Real-World Experience to Understand Renewable Energy Impacts to Wildlife	Pre-existing intellectual property identified in agreement EPC-14-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	U.S. Geological Survey (Forest and Rangeland Ecosystem Science Center - FRESC)	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project developed and applied a unique combination of stable isotope analysis and demographic modeling to characterize wildlife populations of interest affected by fatalities at renewable energy facilities in California. The project also developed a novel application of techniques that evaluates statistical models to improve forecasting of wildlife fatality rates and mitigation outcomes. The approach was high-tech, scientifically-innovative, and ultimately subject to peer-review via publication in scientific journals. Implementation of this set of tools will benefit ratepayers by streamlining permitting and reducing costs of energy development and electricity.	2a, 3a, 4f, 4g	The project was completed in 2019, and the final report was received. Despite compiling more than 600 environmental reports, researchers concluded that it is largely impossible to assess the utility of pre-construction wildlife surveys to predict post-construction effects because of the lack of standardization. About 3,000 samples were prepared for isotopic analysis to determine the geographic origin of individuals. The research team developed populations models for 29 species to estimate the effect of fatalities at renewable energy facilities. Of the birds killed, those of predominantly local origin were especially likely to have lower population growth rates (they are declining) and greater adult survival (they are long-lived). The team shared sample material from carcasses with the team from EPC-15-043. The study published two journal articles, with several more underway.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-062 Energy Efficiency in California's Water Sector Using Customized Energy Management and Supervisory Control and Data Acquisition Systems	Technology Demonstration and Deployment	This project involves setting up links using software and hardware at pumping stations for water delivery, storage or treatment that enable the integration and transmission of data from energy meters directly or indirectly into Supervisory Control and Data Acquisition (SCADA) systems that are traditionally set up to monitor water quality parameters in real time. Combined with historical energy use data on the platform, operators can manage systems in real time to monitor and control peak demand.	5/13/2015	No	Demand-side Management	$3,017,034	$3,017,034	$2,274,513	N/A	$2,274,513	$452,544	$0	Inland Empire Utilities; OSISoft, LLC; Regents of the University of California, Riverside Campus; Opto 22; Cucamonga Valley Water District; Olivehain Municipal Water District	$1,722,732	36.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-063 Advance Wastewater Treatment Using Forward Osmosis to Produce High Quality Water	Technology Demonstration and Deployment	This project demonstrates an advanced wastewater treatment technology, the PFO Recycler, that produces high quality water while reducing energy, chemicals and maintenance required for treatment of industrial wastewaters. The PFO Recycler uses forward osmosis to extract the water from the waste stream and reverse osmosis to extract the water out of the forward osmosis draw solution. If the project is successful then this technology could be used to treat challenging wastewaters to achieve high purity and provide high temperature water for reuse while using less energy than other processes. Reclaiming water for onsite reuse will reduce the need for fresh water purchases.	5/13/2015	No	Demand-side Management	$3,230,420	$3,230,420	$3,230,164	N/A	$3,230,164	$964,131	$0	To Be Determined; Porifera, Inc.; CDM Smith, Inc. ; Dr. Bronner's Magic Soaps ; Jackson Family Wines	$646,493	16.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-064 Aerosol Impacts on the Hydrology and Hydropower Generation in California	Applied Research and Development	The research team enhanced and used a fully coupled aerosol-meteorology-snowpack forecast model for hydropower applications, using observational datasets (precipitation, snowpack, stream inflow) for Southern California Edison's hydropower plant on Big Creek. The main goal was to estimate the impacts of aerosols on hydropower generation and explore the use of improved forecasts to improve the management of hydropower units.	5/13/2015	No	Generation	$399,818	$399,818	$379,062	N/A	$379,062	$92,951	$0	University of California, Riverside; University of California Los Angeles	$306,237	43.4%	Grant

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EPC-14-062 Energy Efficiency in California's Water Sector Using Customized Energy Management and Supervisory Control and Data Acquisition Systems	Pre-existing intellectual property identified in agreement EPC-14-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	University of California, Riverside	Ranked # 6	N/A	N/A	Yes; Calif Based Entity	This project highlighted a pathway for water and wastewater agencies in California to increase energy efficiency and reduce their peak energy consumption with no decrement in service or reliability by monitoring real time energy consumption. This project provided equipment energy data to the water district operators, who can make decisions on optimal equipment operation. The direct benefits to water districts were demand charge savings, O&M savings, and improved operational efficiency.	1e, 1h, 4a	This project was completed in March 2019. All water districts were able to successfully integrate the energy management system (EMS) into their existing SCADA system with the ability to integrate other pumping and treatment sites into the EMS. There were several benefits to the water districts including energy savings, reduction in demand charges, and operations and maintenance savings. All water district operators were able to monitor energy demand in real time to operate the system more efficiently. The EMS deployment at Cucamonga Valley Water District resulted in a 41 percent peak demand reduction from one pumping site. This correlates to annual cost savings, based on demand charges, of $149,146 for one pumping site. To share the results of the project, the Recipient hosted a workshop that brought together local officials, water system integrators and water districts.
EPC-14-063 Advance Wastewater Treatment Using Forward Osmosis to Produce High Quality Water	Pre-existing intellectual property identified in agreement EPC-14-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Porifera, Inc.	Ranked # 2	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	The project includes technological advancements in membrane development and module design in forward osmosis to address cost and performance issues. The demonstration projects are located at a winery, frozen food facility and a soap company. Each demonstration is documenting energy savings and potential for this technology to purify, concentrate and reuse challenging wastewaters that contains high levels of contaminants. This technology has the potential for application in the food and beverage, oil and gas, and other industrial sectors.	1f, 1h, 4a, 4c	Final report is under review for publication. Demonstration results show energy savings of at least 20% when targeting 70% water recovery and at least 40% energy savings when targeting 90% water recovery. The technology has been showcased at the California League of Food Processors Expo for several years and has gotten some interest from the industry to do more projects.
EPC-14-064 Aerosol Impacts on the Hydrology and Hydropower Generation in California	Pre-existing intellectual property identified in agreement EPC-14-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Regents of the University of California, Riverside Campus	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The proposed research is intended to significantly advance our knowledge of aerosol impacts on the hydrology and hydropower generation in California. The results of this project are expected to improve the management of hydropower units which should reduce overall electricity generation costs and assist with adaptation under a changing climate.	1c, 4a, 5c	The research team successfully ran a chemistry-aerosol-meteorological model and coupled this model with a model used by Southern California Edison (SCE) to operate their Big Creek Hydroelectric System. The modeling results suggest that aerosols induce a reduction of annual inflows on the order of 4% to 14% but that the reductions are more significant in the summer. The research team calculated the loss of generation and revenue and found that aerosols reduce hydropower generation by about 6%, which is equivalent to an annual loss of about $3 million a year. The final report was submitted and will be posted in the near future. The researchers have shared results with others via scientific conferences and journal publications. SCE was heavily involved with the research team during the execution of the project and co-authored a conference paper with the research team.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-065 Demonstration of Forward Osmosis to Produce Juice Concentrate, Purify and Reuse Wastewater and Reduce Energy Use	Technology Demonstration and Deployment	This project is demonstrating a new technology innovation, the PFO Concentrator, to reduce the energy, chemicals, and maintenance required for food and beverage processing and waste concentration. The PFO concentrator dewaters fruits and vegetables for production of food and beverage concentrates and purees and could replace energy intensive thermal evaporators. Additionally, water is extracted from the concentrated product for reuse on-site.	5/13/2015	No	Demand-side Management	$2,499,289	$2,499,289	$2,499,284	N/A	$2,499,284	$621,536	$0	Porifera, Inc.; CDM Smith, Inc.; Los Gatos Tomato	$628,568	20.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-066 High-Performance Integrated Window and Facade Solutions for California Buildings	Applied Research and Development	This project develops, validates and quantifies energy impacts of a new generation of high performance building envelope systems such as highly insulating windows, novel window-integrated local ventilation, and dynamic daylight-redirection. It will provide design and management toolkits that will enable the building industry to meet challenging energy performance goals leading to zero net energy buildings. This project considers cost-effective integrated system approaches to reduce energy use associated with HVAC and lighting while improving occupant comfort.	5/13/2015	No	Demand-side Management	$3,000,000	$3,000,000	$3,000,000	N/A	$3,000,000	$1,308,929	$450,000	United States Department of Energy	$450,000	13.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-067 Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems	Applied Research and Development	The project will advance hydrologic modeling and improve the Precipitation-Runoff Modeling System (PRMS) used by PG&E, allowing for more effective management of hydropower resources. The project features an innovative smart wireless sensor network made up of small sensor stations mounted on poles linked by low-power radio, which produces real-time hydrologic data. These data, blended with satellite and Light Detection And Ranging (LiDAR) remote sensing data, have the potential to greatly improve hydrologic forecasting for the Sierra Nevada and other areas in California.	5/13/2015	No	Generation	$1,100,000	$1,100,000	$944,195	N/A	$944,195	$205,897	$0	California Department of Water Resources; University of California Merced	$236,263	17.7%	Grant

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EPC-14-065 Demonstration of Forward Osmosis to Produce Juice Concentrate, Purify and Reuse Wastewater and Reduce Energy Use	Pre-existing intellectual property identified in agreement EPC-14-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Porifera, Inc.	Ranked # 7	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	The technology uses forward osmosis and reverse osmosis in an energy efficient way to achieve the equipment performance of an evaporator and, in addition, generates purified water streams for reuse. This technology could lower energy use and costs for food processing and industrial operations through replacement of energy intensive thermal evaporators and reuse of wastewater streams onsite, rather than disposed through the municipal system.	1f, 1h, 4a, 4c	Project has been completed and the final report is under review for publication. The results show annual energy savings of up to 72 percent for wineries, 80 percent for industries with brine wastes, and 75 percent for tomato processing. There has been interest in continuing testing of other wine grape juice and even wine concentrate from Jackson Family Wines after the project.
EPC-14-066 High-Performance Integrated Window and Facade Solutions for California Buildings	Pre-existing intellectual property identified in agreement EPC-14-066 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 10	N/A	N/A	Yes; Calif Based Entity	This project further developed highly insulating windows (advanced TRL to 7), window-integrated ventilation systems (advanced TRL to 6), dynamic daylight redirecting systems (advanced TRL to 4), and dynamic, integrated window and facades through advanced controls (advanced TRL to 5). Technology enhancements include thermal improvements to glazing and frame, better management of air flow, ventilation and heat exchange in perimeter zones, doubling the depth of the perimeter zone that is effectively daylighted, and active load management controls in response to whole-building energy and grid needs. This project also improved modeling capabilities for advanced shading and daylighting systems which is a key interest to DOE moving forward. Project simulations indicate these technologies could reduce HVAC energy use up to 39 percent, and lighting energy use up to 54 percent.	1e, 1f, 1h, 2a	Project completed in March 2019. This project advanced knowledge and technologies in five areas: highly insulating windows; energy recovery-based facade ventilation systems (low-energy air flow through the facade); daylight redirecting systems (sunlight from windows reflected deep into the building); daylighting and shading optimization methods (daylight and solar heat gain models for simulating light-scattering shading and daylighting technologies); and integrated window and facades through advanced controls. Since these technologies are early prototypes, the team is continuing to pursue commercial development partners. The California Partnership for Advanced Windows was also formed to identify and overcome market barriers to facilitate market transformation toward highly insulating windows.
EPC-14-067 Improving Hydrological Snowpack Forecasting for Hydropower Generation Using Intelligent Information Systems	Pre-existing intellectual property identified in agreement EPC-14-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	The Regents of the University of California, Berkeley	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project provides improved predictive planning and scheduling tools to manage hydroelectric resources that are needed to adapt to increasing vulnerabilities and uncertainties of a changing climate. This project specifically targets powerhouses operated by PG&E.	2a, 3a, 5c	Project was successfully completed in 2019. The research team installed hardware and collected hydrologic data for water years 2016, 2017, 2018 from four project sites: Grizzly Ridge, Kettle Rock, Buck's Lake, and Humbug. Data from in-situ snowpack measurements helped to improve Snowpack Water Equivalent (SWE) maps by 55%. The project team worked closely with hydrologists from PG&E and updated their working model of the Precipitation Runoff Modeling System (PRMS) from version 2 to version 4, which features updated topographical, climate, and vegetation data. Project results were published in the California 4th Climate Change Assessment Report. In addition, the project team published two peer-reviewed papers.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-068 Evaluation of Cost, Performance and Water Conserving Capability of Hybrid Cooling	Applied Research and Development	This project analyzed the design, performance, and cost of optimized hybrid cooling systems at utility power plant scale to illustrate the potential benefits of hybrid cooling in California. This project uses an existing Excel spreadsheet-based computational tool with the capability of specifying, at an "engineering-level", design parameters for optimized closed-cycle wet, direct dry, and parallel wet/dry hybrid cooling systems. The tool's output is checked against information from participating plants equipped with wet, dry, and hybrid cooling systems. The capability to make rigorous, reliable evaluations of hybrid cooling systems and the trade-offs between economic power production and water resource conservation enables the selection of preferred cooling systems for the economic and environmental benefit of California.	5/13/2015	No	Generation	$581,580	$581,580	$545,174	N/A	$545,174	$0	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-069 Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System	Applied Research and Development	This project advances the understanding of key parameters of long-term energy scenarios and greenhouse gas abatement options in the California energy system. Researchers further developed detailed scenarios and modeling capabilities of the California electricity sector, as well as interactions between the electricity sector and other sectors, and explored the implications of particular policy choices on the electricity system in the medium (2020-2030) and long term (2050). This project provides critical insight into some of the key challenges facing the low carbon transition in the electricity system, the options for addressing these challenges, and the dynamic interactions among these options, which are likely to grow more important over time.	5/13/2015	No	Grid Operations/ Market Design	$700,000	$700,000	$699,921	N/A	$699,921	$286,936	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-070 Wexus Energy and Water Management Mobile Software for the Agricultural Industry	Technology Demonstration and Deployment	This project deploys the Wexus (Water-Energy Nexus) mobile, cloud-based software platform in California's agricultural industry. The Wexus platform leverages existing utility meter infrastructure and helps agribusinesses to quickly assess energy (and water) usage and cost from virtually anywhere on any mobile device. Through customized alerts and reporting, the platform allows farms to quickly respond to changes in energy usage, adjust and optimize equipment in the field, and reduce operational expenses due to energy costs. Through collaboration with project partners, this project will further extend existing water-energy data analysis, visualization and remote controlling capabilities to the Wexus platform to further optimize water-energy resource management in the agribusiness sector.	5/13/2015	No	Demand-side Management	$4,000,000	$4,000,000	$3,943,801	N/A	$3,943,801	$571,397	$0	Wexus Technologies, Incorporated	$1,000,000	20.0%	Grant

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EPC-14-068 Evaluation of Cost, Performance and Water Conserving Capability of Hybrid Cooling	Pre-existing intellectual property identified in agreement EPC-14-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Maulbetsch Consulting	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Hybrid cooling can save substantial amounts of water compared to the traditional wet cooling systems, although there are increased system costs and potentially reduced hot day generating capacity and annual energy production. The results of this study provide information validated by a computer methodology to determine quantitative estimates of the trade-offs among cooling system cost, annual energy production, and water consumption. State regulatory agencies, power system developers and owners, and community groups can use this information to make informed decisions about the most suitable cooling equipment to use at future steam power generating facilities in California. This will help ensure the appropriate balance among the supply of electrical generation, the cost of electricity, and conserving water resources.	2a, 3a, 4c	The final report was submitted in December of 2017 and published in July 2018 at https://www.energy.ca.gov/2018publications/CEC-500-2018-015/CEC-500-2018-015.pdf, https://www.energy.ca.gov/2018publications/CEC-500-2018-015/CEC-500-2018-015.pdf. Results included: 1. Validating the tool output against existing cooling systems. The estimates generated by the tool were comparable to the design and performance of existing systems at full-scale power plants. 2. Comparing costs, performance, and water consumption in differing meteorological conditions as illuminated in the case studies. The team concluded that while the installed cost and the turbine output reduction vary significantly with cooling system choice, the annualized costs do not. 3. Projecting effects of using hybrid cooling at California power plants in the future.
EPC-14-069 Develop Analytical Tools and Technologies to Plan for and Minimize the Impacts of Climate Change on the Electricity System	Pre-existing intellectual property identified in agreement EPC-14-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Energy and Environmental Economics, Inc. (E3)	Group 5: Ranked # 3	N/A	N/A	Yes; Small Business, Calif Based Entity	This project developed options for improving electricity planning methodologies, such that they better incorporate knowledge of how the electricity system will need to evolve over the next 15 to 30 years. The analysis includes a better understanding of how current policy choices will impact long-term climate outcomes, providing critical policy-relevant information to state energy agencies that will be implementing the Governor's energy and climate goals over the next 15 years. The research team estimated the potential costs of reducing GHG emissions by 80% by 2050 and compared these costs with the public health benefits of improved air quality reported by others. They found that the potential public health benefits are in the same order of magnitude than the potential GHG reduction costs.	3f, 4a	The researchers improved their models and data sets, for example, improving the linkage between the E3 model of the electricity system and their PATHWAY model. E3 briefed Chair Weisenmiller and the project's Policy Advisory Committee in November 2017. The final project report is published on the Energy Commission website. Key findings of the long-term energy scenarios research include: 1) renewable power generation needs to exceed the current RPS requirement of 50% set for 2030 if the 2030 emissions reductions goal is to be met; 2) to meet California's 2050 goal of 80% emissions reductions relative to 1990 levels, the electricity system must be comprised of 85-95% zero-carbon electricity by 2050; 3) consumer behavior is the lynchpin to meeting 2030 targets; and 4) additional RD&D is needed to chart a path for hard-to-electrify end-uses (e.g., heavy-duty trucks, industry).
EPC-14-070 Wexus Energy and Water Management Mobile Software for the Agricultural Industry	Pre-existing intellectual property identified in agreement EPC-14-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Wexus Technologies, Incorporated	Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The Wexus software platform has leveraged existing AMI infrastructure and utility Green Button data platforms extensively to offer initial savings to partner farms without the need for additional hardware installations on site. The Wexus platform has also integrated this electricity data into tariff engines to compare rates and to estimate water usage for reporting.	1e, 1f, 1h	In terms of savings results, three of the four farms had substantially lower average electricity usage during the project period, thus achieving the targeted ten percent (10%) reduction from pre-project baseline values. In total, partner farms reduced electricity usage by 1.14 GWh/year or 17.2% on average unadjusted and by 38 MWh/year and one percent on average, when modeled as adjusted. The adjusted results are based upon several statistical models, which attempt to estimate the impact of factors outside the scope of the project (e.g. major farm operation/crop changes, weather, drought conditions, and EE equipment or renewable energy installations). The Wexus team looks forward to continuing to pioneer and refine this M&V/savings model for the agricultural industry and to implement it in new California third party energy efficiency programs.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-071 Rotor-Mounted Bat Impact Deterrence System Design and Testing	Applied Research and Development	The project designed and tested (in lab and field) a new system to discourage bats from colliding with wind turbines. The system uses ultrasound transmitters mounted in an array along the rotor blades, providing complete coverage over the entire rotor and nacelle envelope. A field test study using substantially similar methods to prior bat impact studies was implemented post-installation at the test site to measure the effectiveness of the new ultrasound system.	5/13/2015	No	Generation	$862,875	$862,875	$713,707	N/A	$713,707	$31,238	$249,000	Frontier Wind; Bruce Walker	$36,313	4.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-072 Building a Healthier and More Robust Future: 2050 Low Carbon Energy Scenarios for California	Applied Research and Development	The researchers developed long-term energy scenarios for California that comply with GHG emission targets and goals. The scenarios provide new insights about technology options and by when some of this options should be implemented.	5/13/2015	No	Generation	$700,000	$700,000	$700,000	N/A	$700,000	$236,701	$0	University of California, Berkeley	$65,000	8.5%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-073 Monitoring the Urban Heat Island Effect and the Efficiency of Future Countermeasures	Applied Research and Development	This project evaluates the distribution of air temperatures within urban heat islands in California and enhances the foundation for location-specific assessments of mitigation strategies. In collaboration with local governments and organizations in the Los Angeles Basin, the research team designed and implemented siting of fixed high-quality monitoring stations, supplemented with mobile monitoring and data from existing weather-station networks. This research assesses spatial and temporal variations in near-surface air temperature and recasts these observations for use in validating and calibrating the climate/meteorological models applied to assess potential benefits of urban heat island countermeasures throughout the state.	5/13/2015	No	Grid Operations/ Market Design	$500,000	$500,000	$500,000	N/A	$500,000	$116,818	$0	Altostratus, Inc.	$4,000	0.8%	Grant

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EPC-14-071 Rotor-Mounted Bat Impact Deterrence System Design and Testing	Pre-existing intellectual property identified in agreement EPC-14-071 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Frontier Wind	Group 6: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project created an innovative bat impact deterrent system that may effectively prevent fatal bat interactions with wind turbines. The system has potential to yield a transformational impact on the field of bat impact mitigation. An effective, practical, cost-effective system design and test can enable commercialization and broad deployment of this technology. As a system that can be retrofitted into existing turbines and installed in new wind turbines, this technology could materially overcome a significant challenge of the wind power industry by reducing bat fatalities and injuries from turbine strikes while avoiding costly curtailments.	2a, 3a, 4g	The project concluded in 2019, and the final report was received. Researchers completed the design stage for the system and tested it in their lab. The full system was installed on twelve turbines at Hatchet Ridge in 2016. Bat fatality surveys were conducted on the test turbines and control turbines during the fall 2016 bat migration season. Power supply problems disrupted the field testing, limiting the amount of useful data. Problems with the power supplies were diagnosed and resolved in 2018, but smoke from the Carr Fire prevented installation in time for the 2018 bat migration season. Therefore the team was unable to complete bat fatality surveys in 2019 to collect sufficient data to give a statistically robust estimate of the effectiveness of the system to reduce fatalities.
EPC-14-072 Building a Healthier and More Robust Future: 2050 Low Carbon Energy Scenarios for California	Pre-existing intellectual property identified in agreement EPC-14-072 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Lawrence Berkeley National Laboratory	Group 5: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The researchers developed a stochastic version of their electricity model to explore issues such as path dependences. The preliminary final results indicates, among other things, that achieving the 2030 GHG target will be extremely difficult with a high percentage of natural gas appliances still in operation. However, this target can be met if California starts electrifying energy services and decarbonize power generation at a fast rate. The electrification of the industrial sector will be difficult even though the electrification technical potential is high. This is mostly due to the costs associated with electrification of the industrial sector. The use of PVs in disadvantages communities may not substantially improve local air quality or public health.	2a, 3f, 3h, 4a	LBNL and UC Berkeley have developed several long-term energy scenarios for California. The team attempted to harmonize assumptions with E3 and UC Irvine. These two entities performed similar analyses (long-term energy scenarios) than LBNL/UCB, but using different tools. The LBNL/UCB team is modeling the entire Western Electric Coordinating Council (WECC) to investigate if a changing of geographical coverage can affect the long-term energy scenarios. They also used a more granular model of the electricity system both in space and time with, for example, several load centers in the WECC instead of representing California as one block.
EPC-14-073 Monitoring the Urban Heat Island Effect and the Efficiency of Future Countermeasures	Pre-existing intellectual property identified in agreement EPC-14-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	Lawrence Berkeley National Laboratory	Group 7: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Research improves on-the-ground benefits from urban heat island (UHI) mitigation by verifying relationships between the UHI effect and land use/land cover; using these measurements to calibrate and validate models that estimate benefits of mitigation measures; establishing a baseline of today's UHI effect against which the efficacy of future UHI mitigation (cool community) programs can measured; and leaving in place a set of research-grade monitors that can be used to track changes in the UHI effect.	4a	Having successfully engaged the LA Unified School District in siting of research grade weather stations and developed a mobile monitoring platform for monitoring urban heat island (UHI) effects through strategically charted transects, the team completed its collection and analysis of empirical data portraying urban heat island phenomena in the Los Angeles basin. A final report passed the rigorous peer review process associated with California's Fourth Climate Change Assessment. New findings include identification of dominant determinants of urban heat island impacts in the San Fernando Valley and downtown Los Angeles study areas, namely low vegetation canopy cover and low albedo, respectively. Another key contribution was development of a methodological framework for siting weather stations, monitoring urban heat islands, and empirically substantiating strategies to address UHI.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-074 Building a Climate Change Resilient Electricity System for Meeting California's Energy and Environmental Goals	Applied Research and Development	The project used climate change simulations to model conditions that disrupt electricity system generation, renewable capacity potential, and demand for the years of 2030, 2040, and 2050. The combined effect of these impacts was then simulated on the electricity system using an integrated electric grid modeling platform to determine the shortfall in achieving California's greenhouse gas emissions goals. The project then analyzed the potential benefits of additional mitigation strategies, such as additional energy storage, on reducing emissions.	5/13/2015	No	Generation	$698,792	$698,792	$698,792	N/A	$698,792	$181,613	$750,000	Southern California Gas Company (SoCalGas); Southern California Edison	$300,000	30.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-075 Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems	Technology Demonstration and Deployment	The University of California at Berkeley, Massachusetts Institute of Technology, and the University of Chicago, have partnered with Lightapp Technologies to demonstrate a pre-commercial, software-based, optimized energy management system in industrial facilities. Together, they will demonstrate Lightapp's energy-monitoring system on compressed air systems in 100 California industrial plants served by the state's investor-owned utilities.	5/13/2015	No	Demand-side Management	$4,981,729	$4,981,729	$4,816,314	N/A	$4,816,314	$451,253	$0	University of California, Berkeley	$1,530,590	23.5%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-076 Raw Wastewater Filtration to Increase Organic Removal Efficiency and Achieve Significant Electrical Savings	Technology Demonstration and Deployment	This project is extending the application of Cloth Depth Filters (CDF) to raw wastewater filtration at three wastewater treatment plants in California. The CDF concept replaces the current technology of primary clarification by offering the following advantages: (1) substantially higher removal of organic load resulting in significantly lower aeration electrical power demand, and (2) smaller footprint requirements both for primary and secondary treatment steps. CDF employs established principles of gravitational forces which results in minimal operational and maintenance complexities. The unique attribute which offers promise for CDF technology in raw wastewater is the vertical placement of the filter medium and flow direction of this filtration process. Unlike prevailing filtration systems, the vertical orientation of the filter medium permits heavy solids to settle within the tank.	5/13/2015	No	Demand-side Management	$3,476,085	$3,476,085	$3,392,789	N/A	$3,392,789	$1,184,735	$0	Kennedy/Jenks Consultants; Water Environment Research Foundation; Regents of University of California, Davis; Aqua-Aerobic Systems, Inc.; Process Wastewater Technologies LLC; Linda County Water District	$1,288,340	27.0%	Grant

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EPC-14-074 Building a Climate Change Resilient Electricity System for Meeting California's Energy and Environmental Goals	Pre-existing intellectual property identified in agreement EPC-14-074 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 14 bidders	The Regents of the University of California, Irvine	Group 5: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The primary benefit of this study was addressing a knowledge gap that has hampered energy planners and policy makers. Previous energy planning studies for the state assumed that future climate would be the same as historical or that climate change would have no impact on the energy system. This study revealed that feedback from climate change could disrupt strategies designed to meet California's greenhouse gas reduction and renewable energy goals for 2050. The study also found that the potential shortfalls caused by climate change could be overcome with existing technologies, perhaps aided by policy changes.	2a, 4a	The project was completed in 2018 and provided an understanding of the specific effects of climate change on the electricity system by 2050 and the resulting ability of the system to satisfy California's GHG reduction target. Because the baseline energy scenario did not account for climate change and fell short of the GHG target, the project team explored a set of energy technologies and resource management strategies to determine if they could offset the shortfall. The project generated a more realistic energy scenario for achieving the 2050 GHG target at the lowest cost. This project was conducted in collaboration with two related studies led by Energy and Environmental Economics (EPC-14-069) and Lawrence Berkeley National Laboratory (EPC-14-072), and results of these three studies have been presented to policy makers and legislative staff. Three journal papers were published.
EPC-14-075 Unlocking Industrial Energy Efficiency Through Optimized Energy Management Systems	Pre-existing intellectual property identified in agreement EPC-14-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	The Regents of the University of California, Berkeley	Ranked # 8	N/A	N/A	Yes; Calif Based Entity	The Lightapp technology takes an innovative approach by relating electricity use and operating measurements to the production outputs of specific facility systems. This project will monitor the compressed air systems over time, looking at both the supply side (the compressor) and the demand side (production). The software tool then identifies anomalies and makes recommendations to lower the overall energy intensity of production and save energy and money. This project demonstrates the operational effectiveness and financial viability of deploying a more developed version of the technology in California industries and optimizes electricity consumption in compressed air systems, a common system in many industries.	1f, 1h, 4a	The project is complete. The Lightapp energy management system collected and analyzed data from sensors installed in 102 industrial facilities. The energy management system provided real-time data to facility personnel and customized recommendations on how to reduce energy use and optimize equipment performance. Annualized energy cost savings are estimated to be $812,000 and greenhouse gas reductions estimated to be 1,500 tons for the facilities analyzed. The industrial customer demand for the software-based system was high, with 22 percent of all eligible sites ageing to join the project 41 percent of all project participants opting to subscribe to the service at the end of the project. The Lightapp brand was changed to Zira in September 2019. The Zira platform provides additional functionality to the Lightapp platform to further help manufacturers optimize and reduce energy use.
EPC-14-076 Raw Wastewater Filtration to Increase Organic Removal Efficiency and Achieve Significant Electrical Savings	Pre-existing intellectual property identified in agreement EPC-14-076 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Kennedy/Jenks Consultants	Ranked # 5	N/A	N/A	Yes; Calif Based Entity	This project uses cloth depth filtration (CDF) for raw wastewater filtration to reduce the organic load on the secondary wastewater treatment step, which is the most energy intensive step in the treatment process. This breakthrough treatment using CDF has never been tested nor implemented at wastewater treatment plants. Project results from the 18-month pilot demonstration at Linda County showed that a full-scale primary filtration using CDF technology is a feasible replacement of primary clarification process in the treatment of wasterwater in California.	1f, 1h, 4a	Project results have shown that primary filtration consistently removed 75-85 percent of suspended solids and 40-63 percent of organics from screened raw wastewater. Based on the 18-month demonstration at Linda County, full-scale primary filtration is a feasible replacement of primary clarification. Primary filtration is expected to have estimated annual energy savings ranging from $22,000 to $35,000 per million gallons per (mgd) day of facility average capacity. The project has also shown wastewater capital costs can be reduced in the range of $640,000 to $1.1 million per mgd of facility average capacity. The capital cost savings come from the 60-70 percent reduction in primary treatment footprint and increased secondary treatment capacity. Project team will continue to market this technology to interested water utilities.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-077 Enable Standardized Vehicle-Grid Integration through Development of Universal Standard	Applied Research and Development	The project was intended to design and develop a Demand Clearing House (DCH) to monitor published energy pricing from the California Independent System Operator's Fifteen-Minute Energy Market as well as load forecasts from San Diego Gas & Electric and other participating utilities through an Application Programming Interface translation from Open ADR 2.0b, a Demand Response protocol used by all California Investor Owned Utilities. The DCH would have then used algorithms that convert grid conditions into ISO/IEC 15118 "grid profiles," or Tariff Tables, which in turn would be communicated to 15118-capable charging stations and vehicles. A fully developed DCH would allow utilities to respond to supplemental energy market prices, proving a viable and scalable pathway toward using plug-in electric vehicles to manage variable grid conditions, solar oversupply, and other system wide challenges. This project was terminated early and will not complete.	6/10/2015	No	Grid Operations/ Market Design	$1,499,999	$1,499,999	$356,872	N/A	$356,872	$193,033	$0	Energy Solutions; Center for Sustainable Energy; Broadband Telcom Power Inc.; KnGrid	$162,474	9.8%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-078 Next-Generation Grid Communication for Residential PEVs	Applied Research and Development	The project develops communication interfaces between PEV customers and utilities using cloud-to-cloud OpenADR 2.0b communication with a vehicle charging network and will leverage emerging means for retrieving vehicle information via the ISO/IEC 15118 standard for consideration in the decision process. The communication will be able to gather customer data and receive signals from a third party (utility) for the purpose of optimizing PEV charging in a mutually beneficial manner to the customer and the utility. In addition to investigation and implementation of the ISO/IEC 15118 standard, the project will also investigate using control methods that do not require having vehicle charging information. This may be done through statistical estimation, rate of charge output from charging stations or driver opt-in based on maximum charge needed.	6/10/2015	No	Demand-side Management	$1,500,000	$1,500,000	$1,339,131	N/A	$1,339,131	$139,418	$0	ChargePoint, Inc.	$142,500	8.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-079 Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable more Residential Solar Energy	Applied Research and Development	The purpose of this project is to resolve the limiting conditions that occur on California distribution systems when many PV systems are installed behind a single residential distribution transformer by evaluating advanced inverter functionality with the specific goal of enabling higher penetration of photovoltaics on the grid. The project is identifying, implementing, and testing (both in lab and field) optimal methods by which smart inverters can mitigate the issues that otherwise would limit local high penetrations of residential PV. The process will identify how California Rule 21 functions can be used and configured so that multiple smart inverters work in harmony and will also identify how other naturally-occurring consumer devices, such as electric vehicle chargers and other smart loads, can serve to further enable high-levels of solar PV.	6/10/2015	No	Grid Operations/ Market Design	$1,705,478	$1,705,478	$1,285,598	N/A	$1,285,598	$400,537	$0	Electric Power Research Institute, Inc.; Sacramento Municipal Utility District; Underwriters Laboratories, Inc.; Southern California Edison Advanced Technology Organization; Intwine Connect; ClipperCreek, INC.; Pentair; A. O. Smith Corporate Technology Center; Emerson Climate Technologies	$891,414	34.3%	Grant

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EPC-14-077 Enable Standardized Vehicle-Grid Integration through Development of Universal Standard	Pre-existing intellectual property identified in agreement EPC-14-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	Center for Sustainable Energy	Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Had the project been successful, this project would have advanced the adoption of an open protocol that enables large amounts of new, low cost flexible capacity on the grid. The open protocol could potentially minimize stranded investments in less cost effective forms of flexible grid resources, maximize renewable and PEV integration, and promote a safer, more reliable low carbon future.	2a, 4a, 4b	CSE was unsuccessful in completing this project to develop, test and demonstrate an open-source Demand Clearing House (DCH). CSE experienced numerous project delays due to the loss of a major subcontractor and subsequently their demonstration site. CSE and the Energy Commission determined that the project could not satisfactorily complete before the grant funds expired. These delays ultimately led to the proposed termination of this grant agreement. The only deliverable brought to completion was the DCH Server Specifications, which detail the design capabilities and functionality of the DCH. Work progressed on the DCH software, but was only completed up to 25%. The Server Specifications and "work in progress" software are available to the public for use and continued development. Energy Commission Audit staff concluded their audit and identified unresolved questioned costs.
EPC-14-078 Next-Generation Grid Communication for Residential PEVs	Pre-existing intellectual property identified in agreement EPC-14-078 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	ChargePoint, Inc.	Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will lower or defer costs in upgrading local distribution infrastructure by providing a mechanism for demand management for local distribution networks, specifically managing PEV charging with input from PEV customers, vehicles, and utility signals. The results from this project would allow the utility to optimize a residential customers night time charging while still satisfying the driver mobility needs. The driver will have the same driving experience, generation and transmission resources can be optimized, and the grid costs and emissions can be reduced. ChargePoint determined that pilot participants experienced an average savings of 45 percent and there is potential for increased savings if the participants had increased visibility to monitor their vehicle's SOC, which is enabled by integrating the 15118 standard in the charging station and the PEV.	1g, 1h, 2a, 3f, 4a, 5b	This project was completed in 2018. The final report is going through the Energy Commission's publication process. ChargePoint completed 15118 testing on the Daimler vehicle to send charging schedules to the vehicle and receive them back from the station. The three-month pilot program consisted of 1,005 charging events across 27 drivers in the San Diego Gas & Electric service territory who used the controlled charging schedule 58 percent of the time. Several participants indicated they were interested in using the controlled schedule more if the vehicle's state of charge (SOC) was more visible. Multiple drivers noted that they wished to limit their SOC at 80 percent to take advantage of the vehicle's regenerative braking capabilities or to protect their battery health. ChargePoint determined the pilot participants achieved a 45 percent average bill savings on their vehicle charging.
EPC-14-079 Assessing the Ability of Smart Inverters and Smart Consumer Devices to Enable more Residential Solar Energy	Pre-existing intellectual property identified in agreement EPC-14-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 27 bidders	Electric Power Research Institute, Inc.	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	As the penetration of autonomous (Rule 21) inverters increases, their interactions will grow in importance. This project will help provide a clear understanding of inverter characteristics and of their potential interactions that may help preserve the stability and reliability of the grid, benefiting both consumers and operators. Consumers who invest in solar PV systems (and utilities that provide incentives or expect benefits from PV) wish to maximize the power they can realize from their system. Sharing excess PV generation with local loads may increase the utilization of such systems without negatively impacting the distribution grid.	1b, 3d, 4a, 5a, 5b	The project is currently in the laboratory testing phase. Work on test procedures has revealed inconsistencies among Rule 21 specifications of the California utilities, leading to questions about the proper configuration of currently-installed inverters. New comprehensive test procedures have been developed by the project to investigate these issues and may also provide improved data for modeling advanced function inverters. Recent bankruptcy filing by PG&E slowed lab activities and the difficulties in locating field-test sites was mainly influenced by the absence of Rule 21-compliant inverters from manufacturers; the new compliance deadline is in January 2020 and this makes it difficult to identify a manufacturer within the current project term that has a compliant inverter for field-testing. The project team is in the process of modifying its field testing plans.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-080 Renewable Microgrid for a Medical Center	Technology Demonstration and Deployment	This project is demonstrating the ability of a microgrid to support and sustain the functions of a healthcare facility and to overcome barriers to its deployment. The Charge Bliss team successfully designed, engineered, procured, constructed, and commissioned the microgrid systems at the Kaiser Permanente Hospital in Richmond, California. This included developing a next-generation microgrid controller capable of optimizing renewable energy generation, storage, and delivery and islanding and providing critical system support.	6/10/2015	No	Distribution	$4,776,171	$4,776,171	$4,776,171	N/A	$4,776,171	$729,842	$0	Princeton Power Systems, Inc.; OSISoft, LLC; Kaiser Permanente Medical Center	$2,095,835	30.5%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-081 Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption	Technology Demonstration and Deployment	This project is demonstrating a software tool that links groundwater extraction with smart meter data to provide growers with automated information on energy and water consumption. This data is augmented by weather data and optional soil moisture data from local sensors to provide information to growers regarding irrigation needs. Use of the software program could help inform growers and reduce irrigation while maintaining or optimizing yield. This technology is being applied over 1,000 acres of farms owned by several growers of alfalfa, tomato, pistachios and almonds.	6/10/2015	No	Demand-side Management	$2,292,829	$2,292,829	$2,250,763	N/A	$2,250,763	$332,162	$370,000	UC Santa Barbara; UC Davis; PowWow Energy, Inc.	$535,568	18.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	Technology Demonstration and Deployment	This project is deploying a biomass-fired combined heat and power system to provide heat and power to Plumas County health facilities. Biomass from local forest clearing operations will be used by a new biomass boiler to supply heat to an Organic Rankine Cycle (ORC) power unit. Waste heat from the ORC will be used as a heat source for heat pumps, improving their performance for the winter heating season.	6/10/2015	No	Generation	$2,603,228	$2,603,228	$2,254,391	N/A	$2,254,391	$262,813	$0	Plumas County; Sierra Institute for Community and Environment	$593,316	19.9%	Grant

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EPC-14-080 Renewable Microgrid for a Medical Center	Pre-existing intellectual property identified in agreement EPC-14-080 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 40 bidders	Charge Bliss, Inc.	Group 1: Ranked # 4	N/A	N/A	Yes; Micro Business, Calif Based Entity	This project demonstrates the value of a microgrid to healthcare facilities, including the reduction in energy costs, which are substantial for healthcare facilities, and the ability to support life and safety functions for three hours or longer to supplement existing backup generation and improve the energy reliability of hospitals in crisis situations. In collaboration with the governing agency Office of Statewide Health Planning and Development (OSHPD), the CEC and Charge Bliss are forging new methods and standards to support the resiliency and autonomy of critical healthcare facilities. This project helps inform deliberation of the requirement for healthcare facilities to have diesel backup.	1e, 1h, 4a, 5a	In 2018, the Charge Bliss team continued to make adjustments to the microgrid controller software developed under the agreement to optimize the hospital's energy savings and to increase system run time to 98%. There has been a considerable amount of publicity and information shared with the public. Since the opening ceremony, the project has been highlighted in several articles from local media to industry magazines. The team has performed several presentations to interested groups including the California Society of Hospital Engineers (CSHE) and the Hospital Building Safety Board (HBSB), a division of California's Office of Statewide Health Planning & Development (OSHPD). The final report was received.
EPC-14-081 Irrigation Optimization and Well Pump Monitoring to Reduce Energy and Water Consumption	Pre-existing intellectual property identified in agreement EPC-14-081 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	PowWow Energy, Inc.	Ranked # 1	N/A	N/A	Yes; Small Business, Calif Based Entity	Reduced irrigation techniques have not been adopted by growers because of perceived risks associated with lower crop yield and quality, and lack of equipment and labor to measure water consumption. This project is developing a unique software tool for measuring groundwater extraction and water application, by leveraging smart meter data, as well as existing water data in the cloud and at the farm sites. The tool is unique because it uses smartmeter data to measure water volumes from pumps without installing hardware devices on site. The tool also communicates with the farmer and irrigator to optimize crop yields and water applications.	1f, 1h, 4a, 4c	The project demonstrated on average 13% improvement in energy efficiency (energy savings for the same level of production performance) across a variety of crops and geographies. Project also achieved 9% in water use efficiency improvement (water savings for the same level of yield). If this innovation was implemented successfully across 20% of the farms in California, an estimated annual reduction of more than 66 GWh and 120,000 acre-feet in water use could be achieved. This project also demonstrated that smart meter data can be used to provide daily water records that help with water management on the farm. The project team continues to work with California electric utilities and host on farm workshops to engage new clients. This technology was used to document energy and water savings in the California Department of Food and Agriculture's State Water Efficiency and Enhancement Program.
EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	Pre-existing intellectual property identified in agreement EPC-14-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	Sierra Institute for Community and Environment	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will link emerging technology with opportunities to advance renewable energy, distributed generation, and clean energy job creation. The first-of-its-kind project combines a biomass-fired boiler with an Organic Rankine Cycle electric generator that diverts waste heat to source heat pumps, supplying economical heat and power to a community-scale entity currently experiencing high energy costs. The project will help sustain a market for locally-sourced, sustainable forest biomass, providing jobs to the community and helping to reduce the risk of catastrophic wildfires that threaten transmission infrastructure and public safety.	1f, 1h, 4a, 4b	Facility construction occurred in the first and second quarters of 2018, with all equipment installed and commissioning completed in June, 2018. A ribbon-cutting ceremony was held in April, 2018, which included participants from the Sierra Institute, Plumas County, US Forest Service, community advocates, project developers, and the Energy Commission. Over the summer and early fall of 2018, Sierra Institute secured a steady fuel supply and trained County technicians to operate the system. The system was operated over the heating season from the fall of 2018 through the spring of 2019.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	Technology Demonstration and Deployment	This project is deploying a biomass-fired combined heat and power system to provide heat and power to Plumas County health facilities. Biomass from local forest clearing operations will be used by a new biomass boiler to supply heat to an Organic Rankine Cycle (ORC) power unit. Waste heat from the ORC will be used as a heat source for heat pumps, improving their performance for the winter heating season.	6/10/2015	No	Generation	-$217,967	-$217,967	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-083 College of San Mateo Internet of Energy	Technology Demonstration and Deployment	This project was initiated to demonstrate an integrated solar PV, energy storage, and advanced power electronics within a single module to significantly increase overall efficiencies by minimizing conversion losses. The demonstration was to include the integration of a 250 kW pre-commercial high-yield PV system from Flex, a 500 kWh stationary battery energy storage system, and advanced HVAC system and controls, with an advanced energy management system that uses the Internet of Energy concept to optimize performance of distributed energy resources and the local grid.	6/10/2015	No	Generation	$2,999,601	$2,999,601	$402,626	N/A	$402,626	$411,350	$0	Growing Energy Labs, Inc.; San Mateo County Community College District	$1,235,000	29.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-084 ABEC #4 Renewable Combined Heat and Power Project	Technology Demonstration and Deployment	The project uses biogas derived from on-site dairy manure to generate low-carbon, renewable electricity and to achieve high overall efficiency by capturing waste heat from the power generation system and using it to drive an absorption chiller. The absorption chiller is designed to convert waste heat into chilling capacity, which will be used to chill milk produced by the dairy cows. New absorption chiller capacity directly offsets electricity consumption from existing electric chillers. Combining renewable generation with waste heat collection and cooling, the project increases energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand.	6/10/2015	No	Generation	$3,000,000	$3,000,000	$2,984,446	N/A	$2,984,446	$0	$1,000,000	ABEC #4 LLC CE&S Dairy Biogas	$4,983,619	62.4%	Grant

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EPC-14-082 Advancing Biomass Combined Heat and Power Technology to Support Rural California, the Environment, and the Electrical Grid	Pre-existing intellectual property identified in agreement EPC-14-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	Sierra Institute for Community and Environment	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will link emerging technology with opportunities to advance renewable energy, distributed generation, and clean energy job creation. The first-of-its-kind project combines a biomass-fired boiler with an Organic Rankine Cycle electric generator that diverts waste heat to source heat pumps, supplying economical heat and power to a community-scale entity currently experiencing high energy costs. The project will help sustain a market for locally-sourced, sustainable forest biomass, providing jobs to the community and helping to reduce the risk of catastrophic wildfires that threaten transmission infrastructure and public safety.	1f, 1h, 4a, 4b	Facility construction occurred in the first and second quarters of 2018, with all equipment installed and commissioning completed in June, 2018. A ribbon-cutting ceremony was held in April, 2018, which included participants from the Sierra Institute, Plumas County, US Forest Service, community advocates, project developers, and the Energy Commission. Over the summer and early fall of 2018, Sierra Institute secured a steady fuel supply and trained County technicians to operate the system. The system was operated over the heating season from the fall of 2018 through the spring of 2019.
EPC-14-083 College of San Mateo Internet of Energy	Pre-existing intellectual property identified in agreement EPC-14-083 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	Prospect Silicon Valley	Group 2: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	If successful, this project was projected to result in a 10% reduction in utility demand charges for the College of San Mateo campus in addition to saving another 8% in energy charges from peak demand reduction and efficient energy management measures. In addition, the PV and energy storage system was to be designed in a modular fashion by housing the Energy Storage System and Power Conversion System in a standard 20-foot container enclosure that was being produced to dramatically reduce balance of system costs.	1a, 1b, 1e, 1f, 1h, 1i, 2a, 3a, 3e, 4a	The College of San Mateo released an RFP for construction and installation of the project in February 2017 and selected Opterra in April 2017, but the project experienced several delays related to equipment sourcing and legal requirements. In late July 2017, the College of San Mateo decided to withdraw from the project, because the perceived risks were too great, and they did not believe that the full scope of the agreement could be completed within the agreement term. As the College of San Mateo was providing the demonstration site for the project as well as the majority of the match funds, Energy Commission staff and PSV decided to mutually terminate the project. The Energy Commission issued a Stop Work Order to PSV on August 7, 2017, and the Commission formally terminated the agreement at the October 11, 2017, business meeting.
EPC-14-084 ABEC #4 Renewable Combined Heat and Power Project	Pre-existing intellectual property identified in agreement EPC-14-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	ABEC #4 LLC CE&S Dairy Biogas	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project represents a significant advance in dairy energy management by combining renewable generation with waste heat collection and cooling to increase energy efficiency of the existing dairy by an estimated 10% or more, while also reducing peak grid power demand. The project benefits include substantial reductions in greenhouse gas emissions, lower manure handling costs, and generation and distribution of technical and economic data on community scale power production.	3a, 4a, 4e	The project accepted a PG&E 20-year Power Purchase Agreement with full operation and has collected operational data for one year commencing in the first quarter of 2018. Electrical production from the digester exceeded expected production during 2018. Monthly gross electrical production was more than 680,000 kWh. The project was completed in March, 2019.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-085 Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System	Technology Demonstration and Deployment	This project is demonstrating a combination of advanced PV generation, energy storage, and an energy management system to reduce average daily power and daily peak energy demand by more than 10%. The project includes a smart electrical energy storage system that integrates retired electric vehicle batteries. The generator and storage system are controlled by a commercial-grade microgrid controller. The demonstration site is located in the Robert Mondavi Institute at the UC Davis campus.	6/10/2015	No	Generation	$1,238,491	$1,238,491	$1,226,606	N/A	$1,226,606	$124,883	$0	UC Davis; OSISoft, LLC; Solexel	$658,729	34.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-086 Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability	Applied Research and Development	The project developed an integrated vehicle-to-grid (V2G) system that was tested and demonstrated to be distribution-aware, self-regulating, interoperable, secure and open as well as scalable and flexible. These real-world test and demonstration results can provide confidence in the V2G systems that provide grid support functions and possibly influence investor owned utilities (IOUs) to add them to their Assembly Bill 2514 Storage Mandate compliance plans. The data gathered and analysis validated the cost effectiveness models through direct engagement with the IOUs' existing infrastructure and distribution networks, combined with simulated independent system operator interaction.	6/10/2015	No	Grid Operations/ Market Design	$1,499,977	$1,499,977	$1,483,659	N/A	$1,483,659	$666,988	$5,760,000	Electric Power Research Institute, Inc.	$795,754	34.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-088 Demonstration of Low-Cost Liquid Cooling Technology for Data Centers	Technology Demonstration and Deployment	This project is validating the performance, reliability, cost savings and payback of a data center efficiency technology that uses direct-to-chip liquid-cooling to cut data center cooling energy use. The technology is being demonstrated at two full scale data centers with the goal of minimal operational disruptions during installation. Energy consumption, load, reliability and server performance are being monitored. The results of the demonstrations, along with "lessons learned", will be made broadly available to the data center community and public-policy makers to stimulate adoption of this technology.	6/10/2015	No	Demand-side Management	$3,552,678	$3,552,678	$3,103,726	N/A	$3,103,726	$1,038,931	$0	Lawrence Livermore National Laboratory; Asetek USA, Inc.	$1,519,738	30.0%	Grant

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EPC-14-085 Demonstration of Community Scale Low Cost Highly Efficient PV and Energy Management System	Pre-existing intellectual property identified in agreement EPC-14-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	UC Davis	Group 2: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	The combination of advanced PV and the energy management system will result in a significant reduction in annual grid electricity consumption - estimated at over 80% or a cost savings of roughly $29,000 per year with associated greenhouse gas reductions of about 250 tons per year. Furthermore, the success of this project will provide follow-on benefits to California's large wine industry by proving that winemaking can be an environmentally-friendly process.	1b, 1e, 1f, 1h, 2a, 3b, 4a	The energy system project was installed in December 2018 and commissioned in January 2019.The system has been operating and collecting data since the beginning of 2019 and enabled analysis of the reduction in facility's energy demand. Project's success in second-life batteries applied to energy storage led to a start-up company to commercialize the idea. UC Davis have already a collaboration with Case Western University to share data from the system to aid in developing battery models used to predict the lifetime of these batteries as well as the life-cycle emissions from electric vehicle batteries. Results indicate up to $2,000/mo.in bill savings and up to 3000kgCO2/mo. in additional savings are possible with further controller optimizations. The project hosted tour groups including local or domestic groups and international visitors from different countries.
EPC-14-086 Distribution System Aware Vehicle to Grid Services for Improved Grid Stability and Reliability	Pre-existing intellectual property identified in agreement EPC-14-086 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	Electric Power Research Institute, Inc.	Ranked # 3	N/A	N/A	Yes; Calif Based Entity	PEVs with integrated V2G systems have the potential to simultaneously improve air quality, reduce vehicle operational costs and to reduce grid stress and increase grid reliability and stability. Monitoring at the transformer level with control of V2G provides enhanced local situational awareness and real-time responsiveness to distribution grid conditions. The developed management and monitoring system will have awareness of load, power, temperature, current, voltage, frequency, and PEV customer constraints-information to be utilized to determine need for V2G resource. This approach provides a potentially significant solution for integration of a viable energy efficient energy storage technology into a decentralized grid structure, and with the ability to operate as a unified distributed energy resource aggregation system.	1c, 1e, 2a, 3f	This project was completed in 2018. The final report is undergoing the Energy Commission publication process. EPRI developed an end-to-end capable V2G system that demonstrated grid condition awareness in a safe and outage-immune method. Aerovironment and Kitu completed integration and assembly of J3072 and SEP 2.0b software into the 10 demonstration EVSEs. The research team developed the on-board V2G communication module for the PEV and demonstrated the functionality at UCSD. The value analysis showed a cumulative maximum benefit to the grid (net of cost increment) to range between $450-$1,850/year per vehicle in defrayed or deferred infrastructure upgrade costs, which is about five times more valuable than smart charging for similar grid service applications. The project partners, including the University of Delaware and U.S. DOE, are using the findings to further advance VGI research.
EPC-14-088 Demonstration of Low-Cost Liquid Cooling Technology for Data Centers	Pre-existing intellectual property identified in agreement EPC-14-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Asetek USA, Inc.	Ranked # 3	N/A	N/A	Yes; Calif Based Entity	If successful, the project will validate the performance, reliability, cost savings and payback of a data center efficiency technology that could reduce cooling costs while being able to be installed as a retrofit. This could lead to overcoming barriers to adoption by minimizing operational disruptions and costs compared with conventional installations and retrofits.	1f, 1h, 4a	The project is complete. All data centers are different, and the actual energy saved will vary, based on location and data center design. Demonstration results showed that the technology, RackCDU, is most cost-effectively deployed as a pre-installed solution with the greatest savings in high utilization data centers running high performance computing and high-density data centers. While there is performance improvement and energy savings, retrofits are disruptive and not economically viable. The analysis on one of the data center sites showed 5 percent energy savings. Greater savings of up to 10 percent is possible if the chilled water system was not used for heat rejection or if the data center was designed with the RackCDU technology. Knowledge from this project has been distributed at conferences and to data center operators, industry partners, customers and others.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-003 Demonstration of Community Scale Generation System at the Chemehuevi Community Center	Technology Demonstration and Deployment	The purpose of this project is to deploy and demonstrate a community microgrid to improve site power reliability and resiliency. The Chemehuevi Indian Tribe Community Center microgrid incorporates a 90 kW solar PV system, a 25 kW/125 kWh Primus Power flow-battery combined and integrated with an EnSync Inc. energy management system to reduce peak energy demand for the center by utilizing battery storage to shift building and community loads. The system will also provide uninterruptable power for the center and serve as an Emergency Response Center for the tribe during blackouts or loss of power.	10/14/2015	No	Distribution	$2,588,906	$2,588,906	$1,749,988	N/A	$1,749,988	$525,157	$0	Primus Power; The Regents of the University of California - Riverside; OSISoft, LLC; Solexel; Chemehuevi Indian Tribe; SunPower Corporation, Systems	$706,698	21.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-004 Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand	Applied Research and Development	This project is developing and demonstrating a Climate Appropriate Air Conditioning system for commercial buildings that optimizes occupant comfort and can reduce energy use and peak demand. The project will apply a combination of Variable Refrigerant Flow (VRF) technology with Indirect Evaporative Cooling (IEC) integrated and operationally optimized through the building control system. The project will also investigate alternative non- Ozone Depleting Potential (ODP) or low global warming (GWP) refrigerants and HVAC system designs that could enable their usage in commercial buildings. This project will benefit small and medium commercial buildings, such as retail stores, offices buildings and food service and could be implemented in existing and new commercial buildings through direct replacement of rooftop packaged air conditioners. It is estimated that the HVAC systems for these sectors use 7,000 GWh and contributes 5 GW of peak demand.	7/8/2015	No	Demand-side Management	$2,834,721	$2,834,721	$1,724,956	N/A	$1,724,956	$1,088,673	$0	Electric Power Research Institute, Inc.	$440,509	13.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-005 Potential Impacts and Adaptation Options for the Electricity System from Sea Level Rise in the San Diego Area.	Applied Research and Development	The project evaluated SLR vulnerability and adaptation options in the SDG&E service area at a level of detail appropriate for informing electricity sector policy and planning. ICF International partnered with SDG&E to conduct a detailed and robust sea level rise vulnerability assessment and to identify and evaluate appropriate adaptation measures. This project identified adaptation measures for the electrical system that are actionable and aligned with existing policies, based on a comprehensive understanding of the vulnerabilities of specific assets, how these combine at a system level, and significant feedback from the utilities. The results were formed with significant input from the IOU to ensure the adaptation measures are actionable.	10/14/2015	No	Generation	$499,929	$499,929	$478,037	N/A	$478,037	$240,425	$0	San Diego Gas & Electric Company	$166,200	25.0%	Grant

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EPC-15-003 Demonstration of Community Scale Generation System at the Chemehuevi Community Center	Pre-existing intellectual property identified in agreement EPC-15-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	16 out of 22 bidders	The Regents of the University of California - Riverside	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The project will result in greater electricity reliability, lower electricity costs, reduced peak energy demand, and avoidance of failures and outages by integrating a scalable system in both size and quantity and demonstrating the commercial feasibility to deploy many megawatt-hours of dispatchable energy integrated in a photovoltaic-battery storage configuration.	1e, 1g, 1h, 2a, 3f, 4a, 5a	The project team completed the deployment, testing, and successful commissioning of the microgrid system in late 2018. In the first week of April 2019, the system was connected to SCE grid and started operation. However, during the first three months of operation, the Primus Power flow battery experienced technical issues and performance limitations. At the same period, EnSync Inc. experienced financial problems and went out of business. With two key subcontractors unable to support the operational needs of the project, CEC held a CPR meeting and issued a SWO for the project in August 2019. The SWO was released in October 2019 after the recipient provided an equipment replacement plan to upgrade the microgrid system and complete the project as originally envisioned and within the current budget and project term.
EPC-15-004 Climate appropriate HVAC Systems for Commercial Buildings to Reduce Energy Use and Demand	Pre-existing intellectual property identified in agreement EPC-15-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 9	N/A	N/A	Yes; Calif Based Entity	The technology advancement is the intelligent HVAC controller that processes signals from building sensors and system feedback to maximize system efficiency while also synchronizing operation of the VRF and IEC to reduce energy use and peak energy demand and maximize occupant comfort. The innovative control system utilizes cloud based optimization using weather, grid conditions and occupancy (CO2) as inputs to optimally operate a VRF and the IEC system to reduce both energy and water use. The IEC will be set up as a dedicated outdoor air system and incorporate variable speed blower and heat recovery ventilation. These subsystems will also be intelligently controlled by the building controller. This project will also evaluate and provide system designs that use alternative refrigerants that have zero ODP or low GWP.	1f, 1h, 4a	All projects test sites in San Diego, Alisio Viejo and Davis are being monitored and the final report is being drafted. Initial test results show electric savings of about 33 percent. Minor issues being addressed with new Melrok controller. Bundgard propane chiller system being tested, and CO2 and ammonia chillers have completed testing.
EPC-15-005 Potential Impacts and Adaptation Options for the Electricity System from Sea Level Rise in the San Diego Area.	Pre-existing intellectual property identified in agreement EPC-15-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	ICF Incorporated, L.L.C.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Detailed SLR inundation modeling that builds on previous studies is used to identify the SDG&E infrastructure that will be exposed to coastal flooding and assess how the electricity system could be affected. Impacts of coastal inundation and possible adaptation measures are determined using literature reviews, interviews with key experts, modeling, and workshop elicitation. Potential direct and indirect impacts are used at an asset-by-asset level and through system-wide assessment, including power flow modeling to support a "value of lost load" analysis. This level of information was not previously available to SDG&E for use in its planning.	5a, 5d	Working closely with SDG&E, the research team first collected information on specific infrastructure assets and operations, and identified potential climate impacts. The climate impact vulnerabilities of the electricity system were then identified and discussed with the utilities. A matrix of assets and electricity service categories was developed in 2016. The research team collected information on electricity system adaptation measures and presented them to the utilities at a series of workshops to obtain feedback in summer and fall of 2017. The utilities are already using some of the results from this study for adaptation planning.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-006 Modeling the Impact of Wildfires on California's Transmission and Distribution Grid	Applied Research and Development	This study advanced scientific knowledge by combining and enhancing several state-of-the-art models to produce the most detailed analysis to-date of California's current and future electric transmission and distribution grid and fire risk under alternative conditions of climate change and grid evolution.	10/14/2015	No	Distribution	$500,000	$500,000	$500,000	N/A	$500,000	$169,786	$0	University of Hawaii at Manoa	$17,157	3.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-007 Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat	Applied Research and Development	This project developed a sophisticated description of future electric grid demand, response, and vulnerability due to increased (and prolonged) heat events in Southern California Edison territory under current and future climate scenarios. It will enable innovative grid management and operation strategies and will identify adaptation guidance. Researchers provided the information to local governments, regional and state agencies, utilities, and the general public in tangible, easy-to-understand policy briefs to enhance local and state capacity to respond to potential disruptions in distribution due to climate change.	10/14/2015	No	Distribution	$500,000	$500,000	$383,671	N/A	$383,671	$84,000	$0	County of Los Angeles; The Regents of the University of California, Los Angeles	$183,753	26.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-008 Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt	Applied Research and Development	This project developed an interactive web-based platform to provide electricity system stakeholders with actionable data pertaining to local climate risks. The project developed web-based visualization applications depicting climate-related risks of relevance to the electricity infrastructure. The project also provided for access to climate, sea-level rise, hydrological, and wildfire projections associated with California's Fourth Climate Change Assessment. Data access is key to enabling integration of projected climate into infrastructure planning and risk management. As articulated by electricity investor-owned utilities in the 2017 IEPR Adaptation Workshop, Cal-Adapt 2.0 is an instrumental tool for developing and implementing locally-appropriate adaptation options in the electricity sector.	11/12/2015	No	Grid Operations/ Market Design	$400,000	$400,000	$398,891	N/A	$398,891	$74,324	$0	None	$0	0.0%	Grant

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EPC-15-006 Modeling the Impact of Wildfires on California's Transmission and Distribution Grid	Pre-existing intellectual property identified in agreement EPC-15-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project identified segments of the electric grid that are now or will become most vulnerable to increasing wildfire risk. This knowledge allows operators to improve maintenance of grid reliability and safety while adapting to the challenge of changing climate. Researchers applied a unique methodology to measure wildfire risk, allowing them to relate an evolving wildfire probability over time with an evolving electricity grid. The methodology analyzed the cost benefits of grid adaptations for minimizing the risk associated with future wildfires.	2a, 5a, 5d	This project was completed in 2018. The final report, included in California's Fourth Climate Change Assessment, is available online at http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-002.pdf. The researchers obtained the maps of future burned area being used for California's Fourth Climate Change Assessment as the basis for their study of future risk to the transmission and distribution system. They mapped current and future exposure of operationally significant segments of transmission paths to wildfire. They used land use projections of urban expansion as a proxy for the extension of the distribution grid. Then they used the PLEXOS model to estimate the cost of fire-caused outages with and without wildfire forecasts, such as the change in generation costs as other power plants are dispatched to replace the stranded generators during the outage.
EPC-15-007 Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat	Pre-existing intellectual property identified in agreement EPC-15-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	The Regents of the University of California, Los Angeles	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project integrated a set of models in a novel way to link new results on extreme heat events in Los Angeles County with electricity demand projections that respond to these events and then to model how these climate impacts would affect the vulnerability of electricity supply and the transmission and distribution networks. Doing so created a greater level of understanding on where the grid is most vulnerable, which neighborhoods each circuit serves, and what types of adaptation measures may need to be taken by the utility as well as state, regional, and local actors. The project can equally help guide investments in distributed generation that could alleviate pressure on the conventional electricity generation system.	1e, 2a, 5a, 5d	This project was completed in 2018. The final report is available online as part of California's Fourth Climate Change Assessment at http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-13.pdf"]http://www.climateassessment.ca.gov/techreports/docs/20180827-Energy_CCCA4-CEC-2018-013.pdf. The research team projected peak demand for Los Angeles County due to climate change. An 8-11% increase of substation capacity, DER, or peak load shifting will be needed throughout Los Angeles County to keep substation load factors at or below 1 during the worst-case heat waves by 2060. The team conducted an extensive outreach effort to inform utilities and others. The team is briefing CPUC for R.18-04-019 on strategies and guidance for climate change adaptation. Three journal papers will be published. The South Bay Cities Council of Governments intends to use the electricity demand and grid vulnerability projections in developing their climate action plan.
EPC-15-008 Visualizing Climate-Related Risks to the Electricity System using Cal-Adapt	Pre-existing intellectual property identified in agreement EPC-15-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	12 out of 13 bidders	The Regents of the University of California, Berkeley	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The platform developed in part by funds from this project continues to provide interactive visualizations and tools for download of data that directly support electricity sector decision-making with regard to infrastructure planning and management. In September, 2019, CPUC's decision on Topics 1 and 2 of its adaptation rulemaking anchored acceptable data for use by investor-owned utilities in California's Climate Change Assessment process. CPUC's decision points to Cal-Adapt as a key data source, as free access to the data recommended by California's most recent (fourth) climate change assessment is provided on Cal-Adapt. Use of Cal-Adapt 2.0 to build climate resilience contributes multiple benefits to California's electricity ratepayers by helping to stabilize the grid, improve service reliability, and reduce financial losses associated with power outages.	5a, 5d	In November 2019, CPUC issued Decision 19-10-054 (Phase 1 of Adaptation Rulemaking18-04-019), which defines climate adaptation for investor-owned energy utilities in the state and directs IOUs to Cal-Adapt as a source of acceptable data for making resilient investments. In summer of 2019, the project final report was developed and submitted for publication.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-009 Workforce Instruction for Standards and Efficiency (WISE)	Market Facilitation	This project is providing education, outreach, and resources for California's new residential building industry on high performance attics (HPAs) and high performance walls (HPWs), two new requirements in the state's 2016 Building Energy Efficiency Standards. The project helps the new residential building industry to better understand new requirements and options for compliance, and provides them with technical support to enable the transition to the new requirements. Additionally, the project team provides on-the-job training to homebuilders, installing trades, subcontractors, and field crews, on the proper installation of insulation, and on changes to other building systems that will be necessary to meet the new requirements.	11/12/2015	No	Demand-side Management	$4,431,918	$4,431,918	$3,184,527	N/A	$3,184,527	$1,667,291	$0	ConSol ; BASF; Owens Corning; KB Home; California Building Industry Association (CBIA); APA - Engineered Wood Association; Bayer Material Science; Ensoltis Green Hybrid Roofing; Panasonic Eco Solutions North America; PCBC; QC Manufacturing; Shea Homes; SIPA - Structural Insulated Panel Association; SPFA - Spray Polyurethane Foam Alliance; Taylor Morrison Homes of California, LLC; Tru Team of California	$15,685,075	78.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-010 Expanding Energy-Related Career Pathways in the Electrical Industry: Increasing Workforce Development Opportunities in Disadvantaged Communities and Delivering Training on Automated Demand Response Communication Equipment to Inside Wireman Apprentice	Market Facilitation	The project is recruiting workers from disadvantaged communities into apprenticeship programs at California Joint Apprentice Training Centers (JATCs), providing them with comprehensive classroom and on-the-job training on the installation and maintenance of AutoDR communications equipment. By addressing the acute skills gap by producing a workforce qualified to install and maintain cutting-edge AutoDR communications equipment, the project is enabling demand response to be deployed in the market at scale.	11/12/2015	No	Demand-side Management	$4,476,189	$4,476,189	$1,994,025	N/A	$1,994,025	$863,874	$0	California LMCC IBEW-NECA	$16,165,080	78.3%	Grant

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EPC-15-009 Workforce Instruction for Standards and Efficiency (WISE)	Pre-existing intellectual property identified in agreement EPC-15-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	California Homebuilding Foundation (CHF)	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The California Energy Code now requires new homes to be constructed with HPAs/HPWs, to meet energy efficiency standards. This project helps overcome market barriers for HPAs/HPWs by providing the construction industry with access to on-the-job training and tools on the best available technologies, techniques, and practices for complying with the new requirements.	1c, 1e, 1f, 1h, 2a, 3c, 4a, 4b	The team provided training and technical support to the building industry on HPA/HPW practices, including impacts of the 2019 Title 24 requirements on code compliance. This included a two-day classroom and hands-on training at a Passive House (built for high energy efficiency), educating industry participants on compliance options and proper installation techniques. Training modules were developed for a new online certification through High Performance Insulation Professionals. Informational materials and success stories were also updated on the project website: www.wisewarehouse.org. Finally, a new HPA/HPW curriculum was developed for the Building Industry Technology Academy, a statewide high school program that incorporated it into their annual build challenge for Southern California. The team will continue offering training and scale-up measurement and verification activities in 2019.
EPC-15-010 Expanding Energy-Related Career Pathways in the Electrical Industry: Increasing Workforce Development Opportunities in Disadvantaged Communities and Delivering Training on Automated Demand Response Communication Equipment to Inside Wireman Apprentice	Pre-existing intellectual property identified in agreement EPC-15-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	4 out of 4 bidders	Center for Sustainable Energy	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The California Energy Code was updated in 2013 to require lighting systems in large buildings to be capable of receiving and automatically responding to at least one standards-based messaging protocol which enables demand response. This project is helping ensure a workforce that is trained in the proper installation and maintenance of AutoDR communications equipment exists to meet California Energy Code requirements for commercial buildings.	1e, 1g, 1h, 2a, 3f	In 2019, the JATCs continued providing their online and in-person courses, and CSE continued working with project partners in disadvantaged communities to recruit new apprentices. Through November 2019, a total of 360 students have completed the course either in-person or online, and enrollment continues to grow. CSE also developed a green business network toolkit, as well as outreach materials for local governments and municipalities to encourage participation in the investor-owned utility demand response incentive programs. Towards the end of the year, CSE began efforts to start winding down the agreement, and will submit the final report in early 2020. To learn more about this project, visit: http://energycenter.org/demand-response .

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-012 Improving Membrane Treatment Energy Efficiency through Monitoring the Removal of Colloidal Particle Foulants	Technology Demonstration and Deployment	The project demonstrated an online monitoring technology for wastewater treatment plants to directly measure colloidal particle concentrations in order to lower membrane fouling and reduce energy use and maintenance costs. Direct detection of colloidal particles will help determine the optimal pretreatment needed to minimize deposition of colloidal particles in membrane pores.	12/9/2015	No	Demand-side Management	$1,167,034	$1,167,034	$831,246	N/A	$831,246	$429,784	$0	Orange County Water District; West Basin Municipal Water District; Evoqua Water Technologies; Malvern	$336,000	22.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-013 Open Source Platform For Plug-in Electric Vehicle Smart Charging in California	Applied Research and Development	The project developed a one-way charging concept for PEVs that maximized intermittent renewable generation and minimized impacts to the distribution grid. The project focused on controlling the charging of plug-in electric vehicles (PEVs) in residential and small commercial settings using a novel and flexible open-source, open-software architecture charge communication and control platform. This software-based platform was embedded in the context of overall utility and residential and business electrical and building automation systems, lending itself to potential broad implementation by commercial interests due to its flexible architecture and "agnostic" approach to communications standards. Control strategies and applications were guided by an assessment of user needs and grid operation and ratepayer benefits, and the potential for one-way PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid.	2/10/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,357,291	N/A	$1,357,291	$262,826	$0	BMW of North America	$90,000	5.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-015 Grid Communication Interface for Smart Electric Vehicle Services Research and Development	Applied Research and Development	Andromeda Power developed an advanced smart grid communication interface that allows utilities to send dispatch signals to PEVs in real-time to optimize the bidirectional power flow of PEV battery packs depending on local power conditions such as congestion, power quality, voltage and frequency, while maintaining the driver's mobility needs. The grid communication interface operates with a virtual machine that is able to interface with PEVs of any standard. The real-time monitoring and control of the stations provided the California electric investor-owned utilities with a means of quick, automated demand response.	1/13/2016	No	Demand-side Management	$681,693	$681,693	$622,482	N/A	$622,482	$223,081	$0	Suncharge; Verdek	$465,000	40.6%	Grant

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EPC-15-012 Improving Membrane Treatment Energy Efficiency through Monitoring the Removal of Colloidal Particle Foulants	Pre-existing intellectual property identified in agreement EPC-15-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 43 out of 46 bidders; phase 2: 10 out of 13 bidders	Kennedy/Jenks Consultants	Ranked # 9	N/A	N/A	Yes; Calif Based Entity	Nationwide there are over 100 microfiltration/ultrafiltration treatment plants and there are over 100 reverse osmosis facilities in California using membranes. Membrane treatment for wastewater treatment is very energy intensive due to fouling of membranes over time. This project could overcome the barriers to use of membrane treatment by demonstrating a technology that can detect colloidal particles in membrane feed water. This can facilitate an optimal pretreatment process for their removal and reduce membrane fouling and energy costs.	1f, 1h, 4c	Project is complete. Results indicate that the fouling potential for the microfiltration (MF) membranes tested at Orange County Water District (OCWD) was mitigated through use of targeted chemical addition. Test results show that fouling is reduced by 60% compared to the no coagulant addition. Energy and economic evaluation at OCWD indicated that the approach can reduce energy consumption due to MF by 28% and can result in 2,940 MWh/year savings. OCWD staff has made internal presentation of the project findings to its management. Recipient has presented the project results at five conferences attended by water/wastewater treatment plant staff, regulators and vendors. This project will be published in "Water World" either as a podcast/article.
EPC-15-013 Open Source Platform For Plug-in Electric Vehicle Smart Charging in California	Pre-existing intellectual property identified in agreement EPC-15-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	The Regents of the University of California, Berkeley	Ranked # 4	N/A	N/A	Yes; Calif Based Entity	This project focuses on controlling the charging of plug-in electric vehicles PEVs at residential and small commercial settings using a novel and flexible open-source, open-architecture charge communication and control platform. This XBOS-V platform is embedded in the context of overall utility and residential and business electrical and building automation systems, lending itself to potential broad implementation by commercial interests. This integrated project also focuses on the development of the open-source platform including assessment of user needs and grid operation and ratepayer benefits, grid security considerations, and the potential for PEV charge control to lead to increased ability to accept intermittent renewable energy for California's electrical grid. The platform is flexible to adoption and inclusion of several communication protocols.	2a, 3h, 4a	This project was completed in 2019. This project developed and demonstrated electric vehicle charging and building load aggregation and management in response to 15-minute ahead grid condition signals. The research team demonstrated local load optimization to reduce site energy consumption while meeting driver mobility needs, building functionality, and building occupant comfort. Load management strategies such as the one demonstrated in this project can have the potential to save ratepayers $15M per year in 2024 in lowered utility costs (at 1 percent market penetration). The research team has released the source code on GitHub for public consumption, which has been downloaded about 50 times. About 20 buildings are currently capable of integrating the developed charging communication and control platform. The research team cannot track the number deployments.
EPC-15-015 Grid Communication Interface for Smart Electric Vehicle Services Research and Development	Pre-existing intellectual property identified in agreement EPC-15-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	25 out of 25 bidders	Andromeda Power, LLC	Ranked # 5	N/A	N/A	Yes; Calif Based Entity	This project enables the harmonization of V2G services, removing the communication barrier between PEVs of different standards and the grid. The communication interface enables Smart Demand Side Management benefits to the ratepayer with the possibility of using PEVs as distributed energy storage and controllable load. Local PEVs can mitigate the renewable over-generation and intermittency by storing renewable energy and delivering it to the grid on demand, potentially saving $1,861 per year for each PEV. The additional smart charging incentive can accelerate PEV adoption to achieve the targeted 1.5 million ZEVs on the road by 2025 and 5 million by 2030. Using PEVs as an energy storage resource can reduce energy demand and stress of the grid, making the load predictable and more manageable.	1g, 2a, 4a, 5b	This project was completed in 2019. The project team designed and prototyped two models of Level 2 chargers capable of demand response according to the V1G (managed charging) use cases defined by SCE and PG&E. The project team conducted fast charge and discharge simulation of the PEVs using OpenADR signals and collected performance data. The EVSEs (Level 2 and Level 3) were integrated in a microgrid with 110 kW solar panels to demonstrate the feasibility of the InCISIVE system in mitigating renewable energy overgeneration. Using low-priced renewable energy stored in PEVs instead of energy from natural gas peakers results in energy savings of 21.9 MWh and about a $3,700 savings per PEV per year for California ratepayers.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-016 A Transformative Flywheel R&D Project	Applied Research and Development	This project developed advanced manufacturing processes and improved the flywheel rotor geometries. The project built on developments that the Amber Kinetics flywheel team has made in the areas of enhanced materials processing for better strength, longer life, and improved rotor geometries to maximize energy storage density and reduce the costs. The team also conducted extensive performance testing.	1/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$1,997,631	N/A	$1,997,631	$388,000	$0	Amber Kinetics, Inc.	$7,500,000	78.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-018 Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems	Applied Research and Development	This project is developing and testing behind-the-meter residential and CI battery storage applications, on both a stand-alone basis and modeled with solar PV. This project is utilizing several kW-scale, AC-integrated Znyth battery technology storage systems. The residential and commercial systems will be located at the University of California, San Diego (UCSD) campus. The project team is developing, modeling, and will be testing experimental rate designs and evaluating the impact on customer load profiles; developing control algorithms and demonstrating aggregation of multiple storage units to create virtual power plants that maximize the value of behind-the-meter storage to the utilities; and modeling, simulating, and extrapolating the economic impacts of installed systems and quantifying the benefits to California utilities and ratepayers.	1/13/2016	No	Grid Operations/ Market Design	$1,894,866	$1,894,866	$1,302,092	N/A	$1,302,092	$218,866	$0	Eos Energy Storage, LLC	$1,436,801	43.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-019 Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	Applied Research and Development	This project is researching shallow (20-30 feet deep) and large diameter (2-3 feet diameter) helical coil, ground heat exchanger designs for ground source heat pumps. The project team is developing models, validating them with field data from two home sites and an outdoor lab, identifying optimal designs, and developing modeling methods that can be adapted for use with code compliance tools. The project also produces design specifications that will support future Title 24 eligibility criteria. A design guide is being developed for industry as a training aid, and a position paper is being prepared for the Department of Water Resources' California Geothermal Heat Exchange Well Standards Stakeholder Advisory Group.	3/9/2016	No	Demand-side Management	$1,212,186	$1,212,186	$663,535	N/A	$663,535	$338,049	$0	Frontier Energy, Inc.	$18,826	1.5%	Grant

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EPC-15-016 A Transformative Flywheel R&D Project	Pre-existing intellectual property identified in agreement EPC-15-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Amber Kinetics, Inc.	Group 2: Ranked # 7	N/A	N/A	Yes; Calif Based Entity	This project is built on developments that the Amber Kinetics team has made in the areas of improved materials processing for better strength and longer life, as well as improved rotor geometries to maximize energy storage density, thus reducing the cost of the system. The project adds to the energy storage portfolio of options necessary to meet California's storage needs.	1c, 1i, 2a, 4a, 5b	Amber Kinetics completed their commercial readiness tests of more than 25,000 operating hours. They performed safety validation with burst tests to analyze and improve the flywheel containment design. For grid connection using multi-unit arrays, Amber Kinetics developed communication protocols, multi-array connectivity, charge and discharge operations, and control algorithms for coordinating multiple flywheels, which would be needed in a utility scale deployment. They collected flywheel operational data under real-world conditions to prove the design robustness, reliability, round-trip efficiency, and the ability to balance power and control the state of charge. As a result, Amber Kinetics is expanding its business opportunities in Massachusetts and Australia. A final report was published: https://www.energy.ca.gov/2019publications/CEC-500-2019-012/CEC-500-2019-012.pdf, https://www.energy.ca.gov/2019publications/CEC-500-2019-012/CEC-500-2019-012.pdf
EPC-15-018 Pilot Testing of Eos' Znyth Battery Technology in Distributed Energy Storage Systems	Pre-existing intellectual property identified in agreement EPC-15-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Eos Energy Storage, LLC	Group 2: Ranked # 4	N/A	N/A	No	This project aims to validate the safety, reliability, and performance of a new aqueous, zinc-based battery technology to support customer adoption in behind-the-meter energy storage markets and applications. Behind-the-meter application of energy storage has been identified as a major commercial market for energy storage, which requires detailed field performance data to open up this market for new and emerging energy storage technologies.	1c, 1i, 2a, 4a, 5b	In 2019, Eos commissioned the C&I system and began data collection. It is expected that Eos will integrate the residential system components in 2020, followed by installation, commissioning, and testing at UCSD.
EPC-15-019 Low Cost, Large Diameter, Shallow Ground Loops for Ground-Coupled Heat Pumps	Pre-existing intellectual property identified in agreement EPC-15-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Regents of University of California, Davis	Group 1: Ranked # 12	N/A	N/A	Yes; Calif Based Entity	The project spurs the market for high efficiency GCHPs by evaluating and testing an innovative method to reduce the cost of GHE, whose cost has been a barrier to more GCHP installations. The current method of drilling GHE bores requires costly, specialized deep drilling rigs, that often must be transported from out of state. Instead, by using common, locally available drilling equipment for shallow bores, GHE bore drilling can be done at lower cost. In addition, this technology will be made ready for commercialization by developing modeling tools needed to properly design, size, and evaluate energy savings and to facilitate use with California Title 24 standards compliance tools.	1e, 1f, 1h	The recipient is on track to complete the tasks and deliverables. The CEC's Buildings Standards Office and Engineering Office in Siting, Transmission & Environmental Protections Division provided comments on the Ground Couple Heat Pump Simulation Model tool, which enabled the recipient to set simulation parameters. The team completed installation of instrumentation at the outdoor lab site, and they started lab testing in October 2019. The data from this site will be used to develop a model to study the optimization of the ground heat exchanger design. The team has completed the test plan to validate the model. The validated model will be used to develop relationships describing the performance of shallow-bore, helical ground heat exchangers for use in EnergyPlus.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-020 Intelligent HVAC Controls for Low Income Households: A Low Cost Non-connected Device that Understands Consumer Preferences and Performs Adaptive Optimization	Applied Research and Development	This project is developing a low-cost smart thermostat with a simplified user interface. It is being tested in low-income and senior housing, but can be readily adapted to other building sectors, including small commercial. The smart thermostat will track user preferences and manage indoor conditions to optimize energy use. Internet connectivity is not required. By automatically optimizing thermostat settings, this project determines if smart thermostats can be a cost-effective method to address HVAC energy use in sectors where it does not make sense for building owner or tenant to make HVAC system upgrades.	2/10/2016	No	Demand-side Management	$2,705,759	$2,705,759	$902,723	N/A	$902,723	$903,766	$0	Electric Power Research Institute, Inc.	$427,072	13.6%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-021 Mobile Efficiency for Plug Load Devices	Applied Research and Development	This project designed a methodology guideline for plug load manufacturers to use in developing energy efficient plug load devices. In developing the guideline, the recipient will evaluate mobile design practices, hardware components, and power management software kernels to prove their effectiveness. The results were used to develop the first virtual prototypes and reference designs for energy optimized hardware and software that can guide plug load device manufacturers to reach mobile energy efficiency levels. Manufacturers will use these reference designs to develop and mass deploy energy efficient plug load devices into the marketplace. When these reference designs are used there should be a reduction of energy consumption of residential and commercial plug load devices, such as set-top boxes, TVs, computers, and game consoles. The project defined and introduce a widely accepted industry standard through the Institute of Electrical and Electronics Engineers (IEEE) to support the newly developed unified design methodology and secure its long-term adoption and further evolution.	3/9/2016	No	Demand-side Management	$1,996,999	$1,996,999	$1,996,036	N/A	$1,996,036	$136,800	$0	AGGIOS, Inc.; Freescale; International Rectifier; Keysight; Mentor Graphics; Synopsys	$6,030,450	75.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-022 Power Management User Interface	Applied Research and Development	This project seeks to reduce energy consumption in personal computers by improving how users employ existing power management capabilities. Although all computers have the capacity to enter low-power modes such as sleep, and can be shut down when not in use, this potential for energy savings has not been realized in the majority of desktop computers. These computers remain on at full power when they are not used. The problem is one of user behavior. The project uses a software solution to change user behavior by changing the tool they are using. This approach is firmly based in behavior theory and human-computer interaction research, which have long demonstrated that the interface of a device can change users' behavior.	3/9/2016	No	Demand-side Management	$785,124	$785,124	$775,216	N/A	$775,216	$300,159	$0	None	$0	0.0%	Grant

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EPC-15-020 Intelligent HVAC Controls for Low Income Households: A Low Cost Non-connected Device that Understands Consumer Preferences and Performs Adaptive Optimization	Pre-existing intellectual property identified in agreement EPC-15-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 48 out of 120 bidders; phase 2: 32 out of 44 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 11	N/A	N/A	Yes; Calif Based Entity	This project bridges a technology connectivity gap in low-income and senior communities. Current smart thermostats are expensive, and a lack of broadband internet access makes these devices a bad fit for the low-income market. Developing a low-cost, internet-independent device creates opportunities to expand smart grid infrastructure and capture energy savings associated with automated controls in hard to reach building sectors.	1f, 1g, 1h, 3a, 4a	Full scale pilot testing is ongoing with full participation. Over 100 tenants will test functionality over the two properties. Post installation data collection and the staged development of the user application is ongoing. Baseline data collection based on historical utility data is nearing completion.
EPC-15-021 Mobile Efficiency for Plug Load Devices	Pre-existing intellectual property identified in agreement EPC-15-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	AGGIOS, Inc.	Group 1: Ranked # 1	N/A	N/A	Yes; Micro Business, Calif Based Entity	This project advanced a methodology guideline to help plug load manufactures develop energy efficient plug load devices. The recipient is conducted detailed technical analysis on new software, hardware and power management design and verification methodology, conducted tests on virtual prototypes, verified energy savings, and developed reference designs, in the form of design guidelines. This information is available to the plug load device manufacturers and their suppliers to help accelerate the adoption of mobile efficiency practices across multiple product categories in the shortest time and the lowest costs. As many current plug load devices in the market lack any power management capabilities, similar to those in smart phones, this project paved the way for plug load manufacturers to advance those capabilities into other plug load devices.	1f, 1h	The project is complete and the final report will be published January 2019. The project team completed the energy modeling of the power management system and its use. The team completed an application to IEEE to create standardized energy efficient specifications for plug load devices. This process may take up to two years. The standardization efforts are a key factor in enabling wider adoption of efficiency reference designs to allow a standard, comparable assessment of energy use of various plug load devices. Increased use of reference designs and programming of more efficient standby modes has the potential to reduce annual energy consumption by 20-50%.
EPC-15-022 Power Management User Interface	Pre-existing intellectual property identified in agreement EPC-15-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	The Regents of the University of California, Irvine	Group 1: Ranked # 6	N/A	N/A	Yes; Calif Based Entity	The Recipient developed an open source software call Power Management User Interface (PMUI) that is easy to use and provides feedback to the user on their energy use settings.	1f, 1h	Project is complete. The research examined power management behaviors in a large sample of desktop computers. The recipient developed an open source power user management interface software. More than half of computers with sleep enabled experienced at least one problem with sleep transitions being blocked, and 27 percent exhibited substantially higher idle time and lower sleep time than expected. These sleep blockers reduced the effects of enabling sleep settings. However, treatment subjects still saved an average of 23.7 percent more energy than control subjects with no sleep enabled controls. CalPlug has been demonstrating

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-023 Gaming System Energy Efficiency without Performance Compromises	Applied Research and Development	This project provided a detailed market segmentation and baseline energy demand assessment of the gaming market, including development of measurement and benchmarking protocols for gaming software and hardware. Top-selling gaming PCs and games are then cross-benchmarked and retrofitted to achieve maximum energy savings beyond what commercialized products currently can attain.	3/9/2016	No	Demand-side Management	$1,386,530	$1,386,530	$1,386,530	N/A	$1,386,530	$658,250	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-024 Efficient and ZNE-Ready Plug Loads	Applied Research and Development	This project researches and develops new technologies and strategies to eliminate or significantly reduce energy use in standby mode by redesigning the power supply for plug load devices. This project also develops and demonstrates strategies to remove plug load devices from grid AC power by redesigning these devices to use DC power from photovoltaic power sources.	3/9/2016	No	Demand-side Management	$1,600,000	$1,600,000	$1,600,000	N/A	$1,600,000	$634,531	$900,000	Lawrence Berkeley National Laboratory; EMerge Alliance; Power Integrations; Delta Electronics	$495,000	23.6%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-025 Plug Load Reduction App:RYPL	Applied Research and Development	This project researches methods to reduce home idle loads by utilizing smart meter analytics, an engaging smart phone app, a new online crowd-sourced database of miscellaneous electric loads, and an online efficient product marketplace to educate California residents about the idle load of their home and ways to reduce it. The system is to be piloted within all three electric investor owned utility territories and measure actual energy savings through smart meter data.	3/9/2016	No	Demand-side Management	$884,100	$884,100	$884,089	N/A	$884,089	$634,531	$0	Home Energy Analytics; Enervee Corporation	$350,000	28.4%	Grant

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EPC-15-023 Gaming System Energy Efficiency without Performance Compromises	Pre-existing intellectual property identified in agreement EPC-15-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	This project advanced the design of energy efficient of video gaming computers and consoles by demonstrating system designs that are significantly more efficient than current market offerings. The research results may influence component and integrated system manufacturers and game developers to bring more energy efficient video game computers and consoles into the market without sacrificing the gaming experience. The project identified potential opportunities for codes and standards improvements and/or utility incentives. California ratepayers may benefit by having lower energy use and costs associated with their gaming systems without compromising their video game choices and experience.	1f, 1h	This project is completed and the final report will be published in January 2019. The team conducted energy use testing and analysis of video game computers and consoles, including testing the same game on various devices. The team found no relationship between energy use and device type. There is no regulation affecting this industry yet, so the team recommends establishing voluntary standards similar to Energy Star. The standards would cover: energy ratings, power component rankings, and energy game ratings. The information from this project is available and has been shared to the California Energy Commission to influence codes and standards for computers and video game consoles, and encourage manufacturers to reduce the energy use of these devices.
EPC-15-024 Efficient and ZNE-Ready Plug Loads	Pre-existing intellectual property identified in agreement EPC-15-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Standby power use is the electricity consumed by almost every electrical consumer device plugged in to an electrical outlet. Standby power is responsible for about 3 to 16 percent of residential electricity use. Earlier reductions in standby energy use by single devices have been offset by the growth in the number of devices having standby power use. This project is developing methods to reduce standby power use to zero or near zero. Saving 1 watt corresponds to 8.8 kWh/yr or about $1.50 per device. Developing an innovative family of zero-standby technology solutions and will enable the next generation of electrical devices to draw zero standby power while providing the full range of functionality that are desired by consumers.	1f, 1h, 4a	This project developed technologies to reduce standby power use to near zero watts. Burst mode, sleep transistors, wake-up radio, energy harvesting and storage combinations appear most promising for zero standby power. Coordinated improvements in efficiency, energy harvesting and energy storage will be best strategy to achieve zero standby power use. DC connected loads can be designed to connect directly to DC distribution, thus providing higher efficiency at lower cost. Networks of DC-powered devices can provide other benefits, such as resiliency during power outages. A unique category of energy using devices was identified that provide life safety, health and security to building occupants. The findings of the research were marketed to California based plug load devices manufacturers, as well as to the Energy Commission appliance standards office.
EPC-15-025 Plug Load Reduction App:RYPL	Pre-existing intellectual property identified in agreement EPC-15-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Home Energy Analytics	Group 1: Ranked # 2	N/A	N/A	Yes; Small Business, Micro Business, Calif Based Entity, Woman Own	Idle load is a new concept to most residential energy users and includes appliances and equipment in the off or standby mode but still drawing power. The recipient has developed an innovative smart phone app called Dr. Power which provides residents with information about their idle loads, provides ideas and a plan to reduce the idle loads, and correlates any energy saving actions with smart meter data. This simple to use app tests the theory that if accurate information about energy use is provided to consumers, they will be more likely to engage and take action. This technology has the potential to advance consumer knowledge and overcome barriers to reducing idle loads that could hinder the State's goal of doubling energy efficiency by 2030 and/or achieving zero net energy buildings in the future.	1f, 1h	Dr. Power was designed to and built to reduce residential idle load through user education and behavioral science. It was designed to incorporate smart meter data and measured standby power for specific devices. Over 800 PG&E and SCE customers created Dr. Power accounts. Across 341 PG&E Dr. Power Users, idle load was reduced by an average of 5.4 watts which equates to 47 kWh/yr. The open source database used by Dr. Power contains nearly 170,000 appliances. The public API has been used by three different applications including the AskDrPower.com, which is a unique and comprehensive on-line resource for exploring residential energy use. To have significant impact, more California residents need to know about Dr. Power. This can be done by including Dr. Power in statewide outreach programs, such as Energy Upgrade California and for SCE and SDG&E to provide easy data access for their customers.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-026 Unlocking Plug Load Energy Savings through Energy Reporting	Applied Research and Development	This project is developing an interoperable protocol that can be implemented in all plug-load devices, unhampered by proprietary restrictions which will implement energy reporting to enable plug-load devices to transmit operating information - such as identity, power consumption, and functional state - through a communications network to a central entity. After a communication infrastructure is established for plug-load devices, the data flow can be reversed to send control signals to individual devices. The central management system that this project will demonstrate is well positioned to provide comprehensive control over diverse plug-load devices.	3/9/2016	No	Demand-side Management	$1,630,699	$1,630,699	$1,630,699	N/A	$1,630,699	$123,700	$0	Lawrence Berkeley National Laboratory; Energy Solutions; The Watt Stopper	$494,318	23.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-027 Electric Plug Load Savings Potential of Commercial Foodservice Equipment	Applied Research and Development	This project assesses the reduction potential of electric commercial plug load foodservice equipment at 29 different commercial kitchens and demonstrates the potential for reduced energy consumption through the use of pre-commercial appliance designs and control technologies.	4/13/2016	No	Demand-side Management	$937,469	$937,469	$708,837	N/A	$708,837	$392,763	$0	Fisher-Nickel, Inc.; Pacific Gas and Electric Company; NAFEM; Dalla Corte; Nuova Simonelli; Hatco	$202,450	17.8%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-028 Real World Electrification Options of Energy Services and Environmental Justice (EJ) Considerations	Applied Research and Development	The research team conducted a detailed study about the air quality implications of electrifying energy services such as transportation and space heating. The research team used, as a starting point, E3's prior EPIC study on Deep Decarbonization in a High Renewables Future (EPC-14-069). Estimates of how emissions of criteria air pollutants such as oxides of nitrogen and particulate matter would change with electrification were used as input to a sophisticated air quality model to estimate air quality impacts. The research team evaluated the implications of these air quality improvements on public health.	4/13/2016	No	Generation	$799,444	$799,444	$799,098	N/A	$799,098	$234,351	$0	Electric Power Research Institute, Inc.; South Coast Air Quality Management District	$759,213	48.7%	Grant

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EPC-15-026 Unlocking Plug Load Energy Savings through Energy Reporting	Pre-existing intellectual property identified in agreement EPC-15-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The recipient is developing inexpensive, proprietary-free technologies that can acquire energy use data for networked plug load devices and make them available to building owners. The technologies will be able to identify abnormally large plug load energy use and enable building owners to react to its energy use. The technology could be incorporated directly into California's building codes and other energy efficiency standards.	1f, 1h, 3a, 4a	The recipient demonstrated a set of devices with energy reporting features. The devices covered a wide range, including HVAC, lighting, a vehicle charger, a water heater, electronics (notebook computer and universal serial bus charger), and three external meters. To show these devices operating live, the team created a management system that queries the energy reporting devices for their data, stores the data, and displays it in compelling visualizations. The final report reviews existing communication protocols that support energy reporting and describes how to use them with a proposed reference data model for energy reporting. It also assesses ways that energy codes and standards processes can be leveraged to drive energy reporting technology into the market. The recipient continues to advocate energy reporting, recently forming a committee to revise the existing standard CTA-20147.
EPC-15-027 Electric Plug Load Savings Potential of Commercial Foodservice Equipment	Pre-existing intellectual property identified in agreement EPC-15-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Fisher-Nickel, Inc.	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The project advancement is to bridge the knowledge gap and support the accelerated adoption of advanced appliances and controls by better understanding operator behavior and operational changes that can be made to successfully use new lower energy appliances. The results of this effort will be used to develop real world case studies of successful implementation of next generation plug load appliances, and provide training to food service operators to maximize energy reduction potential for food service equipment. In addition to food service operators, the research results will assist equipment manufacturers in further product development of energy efficient food service equipment and help justify development of utility incentives for purchasing and installing energy efficient foodservice equipment.	1e, 1f, 1h	The project currently has 29 different sites. The recipient has collected baseline data at all sites and installed new equipment at 18 of these restaurants. Plug load meters were installed at each of the test sites to determine baseline electrical consumption. Depending on logistics and site flexibility, between two weeks and three months of baseline data was collected. The field data thus far showed that commercial foodservice plug load equipment has a wide range of energy intensities, based on the operation type and hours. Cumulative energy savings for all plug load equipment can be substantial. The appliance with the highest average daily energy use, the conveyor toaster, used more than 20 times the energy on average than the appliance with the lowest average daily energy use, the soup warmer. Frontier is also testing induction and conduction cook tops.
EPC-15-028 Real World Electrification Options of Energy Services and Environmental Justice (EJ) Considerations	Pre-existing intellectual property identified in agreement EPC-15-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1	N/A	N/A	No	The analysis of health and air quality benefits alongside costs of electrification under this agreement is forming the basis for new cost-benefit metrics that can be used to assess the economic viability of breakthrough technologies. Cost-benefit analyses of this sort can be used to make evidence-based decisions regarding technology financing and deployment.	1f, 1h, 2a, 4a, 4b	The research team delineated long-term electrification scenarios for the residential, commercial, and transportation sectors. For each scenario, researchers estimated emissions of criteria air pollutants at relatively fine geographical resolution and with the necessary temporal resolution for sophisticated photochemical modeling. Results suggest that electrification would result in substantial improvements in air quality and public health based on estimated reductions in maximum summertime 8-hour average ozone concentrations and wintertime PM2.5 concentrations. This analysis of health and air quality benefits alongside costs of electrification offers a basis for new cost-benefit metrics that can be used to assess the economic viability of breakthrough technologies

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-029 Distributed Generation Environmental Planner	Applied Research and Development	This project developed a tool to identify environmentally preferred areas for distributed solar generation (DG). The project demonstrated how disparate spatial information, such as solar capacity, environmental data, and utility infrastructure, can be combined in a site screening tool for effective local DG planning. The project aimed to expand energy planning tools at the local level by leveraging the ongoing development of a statewide planning tools. The existing statewide tool (prototype currently called the "RE Infrastructure Planning Assistant") focuses primarily on environmental screening for utility scale renewable energy development. This project adds more detailed energy and economic information appropriate for distribution-scale solar siting and most importantly incorporates distributed generation into the prototype interactive mapping tool and tests it in Lancaster, California.	4/13/2016	No	Generation	$199,976	$199,976	$199,536	N/A	$199,536	$44,350	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-030 ** San Diego Regional Energy Innovation Cluster	Applied Research and Development	Cleantech San Diego Association to establish a regional incubator program that leverages the region's universities, industries, businesses, economic development organizations, and other key stakeholder groups to support clean energy entrepreneurship in San Diego, Imperial, Riverside and San Bernardino Counties.	4/13/2016	No	Demand-side Management	$3,000,000	$3,000,000	$2,270,053	N/A	$2,270,053	$880,681	$749,802	Cleantech San Diego Association; CONNECT	$3,097,934	38.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-030 ** San Diego Regional Energy Innovation Cluster	Market Facilitation	Cleantech San Diego Association to establish a regional incubator program that leverages the region's universities, industries, businesses, economic development organizations, and other key stakeholder groups to support clean energy entrepreneurship in San Diego, Imperial, Riverside and San Bernardino Counties.	4/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant

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EPC-15-029 Distributed Generation Environmental Planner	Pre-existing intellectual property identified in agreement EPC-15-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Black & Veatch Corporation	Group 5: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This agreement created a prototype, public tool (http://dg-solar.org/) that enables DG PV site selection by providing users both environmental and engineering geospatial data. Having proven the concept in Lancaster, CA, the tool may be expanded to other areas of California that have similar availability of input data. Making information more comprehensive and accessible at the DG level will improve market functioning, while also enabling better DG infrastructure planning that incorporates environmental conservation.	2a, 4f	This project was completed in 2018. The final report is available online at http://www.energy.ca.gov/2018publications/CEC-500-2018-010/CEC-500-2018-010.pdf. The research team designed the technical specifications of the planning tool, developed the web-based application, and compiled and processed spatial data. The tool combines solar resource, environmental sensitivity, cost, and interconnection spatial data layers in a single GIS application. The format of the tool allows user-entered values for a variety of screening parameters that may be of interest to developers, local planners, and government officials. The tool returns maps and lists of parcels that match the user-entered criteria and then generates reports. The completed tool went live online in 2017. The TAC member from sPower is interested in using the tool to guide future solar development in Lancaster.
EPC-15-030 ** San Diego Regional Energy Innovation Cluster	Pre-existing intellectual property identified in agreement EPC-15-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Cleantech San Diego Association	Group 3: Ranked # 1	N/A	N/A	No	This project is advancing the goals of SB 350 (2015) by accelerating the commercialization of new clean energy technologies that can enable the integration of high-penetrations of renewables and distributed energy resources. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2019, the Southern California Energy Innovation Network (SCEIN) expanded the number of currently active startups in the program to over 25. These companies are developing innovations in areas such as storage technology, EV smart charging, and DER aggregation. Collectively, these companies have gone on to attract over $43.1 million in private follow-on funding and over $5.8 million in public follow-on funding since being accepted into the program, virtually doubling follow-on capital raised since 2018. SCEIN has also transitioned its Application Process to the new Empower Innovation Network platform which facilitates better integration with the rest of the Energy Innovation Ecosystem stakeholders and partners.
EPC-15-030 ** San Diego Regional Energy Innovation Cluster	Pre-existing intellectual property identified in agreement EPC-15-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Cleantech San Diego Association	Group 3: Ranked # 1	N/A	N/A	No	This project is advancing the goals of SB 350 (2015) by accelerating the commercialization of new clean energy technologies that can enable the integration of high-penetrations of renewables and distributed energy resources. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2019, the Southern California Energy Innovation Network (SCEIN) expanded the number of currently active startups in the program to over 25. These companies are developing innovations in areas such as storage technology, EV smart charging, and DER aggregation. Collectively, these companies have gone on to attract over $43.1 million in private follow-on funding and over $5.8 million in public follow-on funding since being accepted into the program, virtually doubling follow-on capital raised since 2018. SCEIN has also transitioned its Application Process to the new Empower Innovation Network platform which facilitates better integration with the rest of the Energy Innovation Ecosystem stakeholders and partners.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-031 Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response	Applied Research and Development	This agreement develops integrated plug load control strategies for different spaces within multiple types of commercial buildings. The project implements a flexible energy management system (FEMS) to demonstrate the integrated control strategies for plug loads at pilot sites. This includes the installation of smart power outlets and integration of various plug load control strategies with building energy management and/or lighting control systems. The project demonstrates and measures the degree of effectiveness of the flexible control strategies developed for integrally managing operation of plug loads to achieve energy efficiency and demand reductions.	4/13/2016	No	Demand-side Management	$1,050,022	$1,050,022	$555,929	N/A	$555,929	$366,082	$0	Electric Power Research Institute, Inc.; San Diego Gas & Electric Company; To Be Determined; Enmetrics Systems; Ibis Networks; SkyCentrics; TBD - Technical Writer	$335,120	24.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-032 ** Bay Area Regional Energy Innovation Cluster	Applied Research and Development	This project established the Bay Area Regional Energy Innovation Cluster by expanding the Cyclotron Road program to provide commercialization support services to Bay Area entrepreneurs developing breakthrough materials and hardware devices in energy efficiency, energy storage, distribution, grid management, and power generation. Cyclotron Road provides entrepreneurs access to world-class laboratory facilities, and key services, such as business model development, customer discovery, and intellectual property protection to enable energy entrepreneurs in the Bay Area region.	4/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$1,566,120	N/A	$1,566,120	$282,411	$1,600,000	Autodesk, Inc.; Lawrence Berkeley National Laboratory; Activation Energy, Inc.; DLA Piper LLP	$9,000,000	64.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-032 ** Bay Area Regional Energy Innovation Cluster	Market Facilitation	This project established the Bay Area Regional Energy Innovation Cluster by expanding the Cyclotron Road program to provide commercialization support services to Bay Area entrepreneurs developing breakthrough materials and hardware devices in energy efficiency, energy storage, distribution, grid management, and power generation. Cyclotron Road provides entrepreneurs access to world-class laboratory facilities, and key services, such as business model development, customer discovery, and intellectual property protection to enable energy entrepreneurs in the Bay Area region.	4/13/2016	No	Demand-side Management	$2,980,000	$2,980,000	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant

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EPC-15-031 Flexible Control Strategies for Plug Loads with Context-Aware Smart Power Outlets to Mitigate Electricity Waste and Support Demand Response	Pre-existing intellectual property identified in agreement EPC-15-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	In order to reduce plug load energy use and increase the energy efficiency of buildings, this project advances flexible energy management systems coupled with smart power outlet technology to control plug load use. The project will also enhance integrated strategies for operating different plug load types to achieve energy efficiency and demand response. The results of this project can potentially reduce electricity use in commercial buildings, particularly during low-occupancy times and in user-assigned spaces, thereby achieving lower electricity costs for the ratepayer.	1e, 1f, 1h	The project team is evaluating the 1+ year of data collected to determine effectiveness in achieving energy efficiency and demand reductions with the plug load controls at both the lab and office demonstration sites. Select equipment types were time schedule controlled for energy savings such as the coffee maker in breakroom and centrifuges in biology labs. The project team is working on implementing functionality to engage demand response participation next. Preliminary data showed that energy savings from time scheduling was 80.31 kWh/year per smart outlet. The team is finalizing their development of a heat map display that identifies plug loads that are used more frequently in an office space. The display will show building owners where automated controls will have the biggest impact.
EPC-15-032 ** Bay Area Regional Energy Innovation Cluster	Pre-existing intellectual property identified in agreement EPC-15-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Activation Energy, Inc.	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will help advance the goals of Senate Bill 350 (De Leon, 2015) by accelerating the commercialization of clean energy technologies, including energy efficiency, demand response, renewable generation, energy storage, and smart-grid integration. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2019, Cyclotron Road accepted its fifth cohort of fellows into its program. This latest round of entrepreneurs is developing innovations in areas such as AI for climate and weather risk forecasting, paintable optical coatings, and efficient cogeneration of hydrogen. The fellows will spend the next two years working on bringing their technologies closer to market. Fellows supported by CEC funding have attracted over $8 million in public and private follow-on funding since being accepted into the Cyclotron Road Program. Additionally, Activation Energy received a new grant philanthropic initiative Schmidt Futures, which will allow them to scale the Cyclotron Road fellowship model to new locations supporting more science entrepreneurs. In 2020, Cyclotron Road will accept its sixth cohort of fellows into the program.
EPC-15-032 ** Bay Area Regional Energy Innovation Cluster	Pre-existing intellectual property identified in agreement EPC-15-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	Activation Energy, Inc.	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will help advance the goals of Senate Bill 350 (De Leon, 2015) by accelerating the commercialization of clean energy technologies, including energy efficiency, demand response, renewable generation, energy storage, and smart-grid integration. This project will increase the probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. Intangible benefits to California ratepayers will result from broader, indirect, and multiplicative economic effects that occur from the successful establishment of California-based technology companies.	2a, 3b, 3e	In 2019, Cyclotron Road accepted its fifth cohort of fellows into its program. This latest round of entrepreneurs is developing innovations in areas such as AI for climate and weather risk forecasting, paintable optical coatings, and efficient cogeneration of hydrogen. The fellows will spend the next two years working on bringing their technologies closer to market. Fellows supported by CEC funding have attracted over $8 million in public and private follow-on funding since being accepted into the Cyclotron Road Program. Additionally, Activation Energy received a new grant philanthropic initiative Schmidt Futures, which will allow them to scale the Cyclotron Road fellowship model to new locations supporting more science entrepreneurs. In 2020, Cyclotron Road will accept its sixth cohort of fellows into the program.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-033 Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC	Applied Research and Development	The project includes three phases: 1) conduct energy and indoor air quality measurements in California classrooms to establish baseline data; 2) identify and install new, highly efficient HVAC technologies at selected schools and collect data from these schools; 3) conduct energy consumption and indoor air quality simulations based on information collected from previous two phases in representative climate zones in California, and compare simulation results with field data. The identified technologies in this study include heat recovery ventilators, air economizers, demand control ventilation, displacement ventilation, high-performance filtration, and learning thermostats. These are advancements that are over and above the technologies typically used in California schools, and can greatly improve the energy efficiency of providing heating, cooling, and ventilation in classrooms.	4/13/2016	No	Distribution	$1,500,000	$1,500,000	$1,132,490	N/A	$1,132,490	$439,287	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-034 Emerging Energy Public Health Research Roadmap	Applied Research and Development	This research develops a research needs assessment that focuses on the known and potential public health impacts of emerging energy systems. The needs assessment is based on consultation with experts in emerging energy systems and occupational and environmental health (OEH) and with stakeholder representatives from labor, business, government, and community-based organizations.	4/13/2016	No	Generation	$151,000	$151,000	$150,998	N/A	$150,998	$0	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-035 Clarifying and Quantifying Current and Near-Term Groundwater Pumping Energy Use and Costs in California to Improve Energy and Water Systems Reliability	Applied Research and Development	The project is quantifying current statewide energy use and costs attributable to groundwater pumping and is developing near-term projections of energy use and statewide costs. The projections will factor in groundwater demand, groundwater levels, climate change scenarios, energy prices, and obstacles to implementing energy-efficient pumping and groundwater conservation measures. By expanding knowledge of the relationship between groundwater pumping and energy use, the project will enhance the ability of the State of California and irrigation and drinking water districts to coordinate water and energy resources planning. In addition, the project is providing key insights on how to improve groundwater use and pumping efficiency.	4/13/2016	No	Demand-side Management	$625,000	$625,000	$619,704	N/A	$619,704	$260,000	$0	Michael Hanneman	$22,550	3.5%	Grant

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EPC-15-033 Ventilation Solutions for Energy Efficient California Schools: Improving Indoor Air Quality through Advanced, High Performance HVAC	Pre-existing intellectual property identified in agreement EPC-15-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Regents of the University of California, Davis	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The project provides information on indoor air quality and energy usage in classrooms with current HVAC systems throughout different parts of California. It demonstrated the next generation HVAC system retrofits with regards to energy efficiency and indoor air quality performance. The results enable energy savings without impacting indoor air quality in classrooms. The study is the first large field study to examine the energy efficiency and indoor air quality impacts after recent energy retrofits.	4b, 5d	The project is completed. In phase 1, the researchers collected indoor air quality (IAQ) monitoring, ventilation, and energy usage data from 104 classrooms in 11 schools using current HVAC systems. Researchers discovered high CO2 levels in some classrooms, suggesting poor ventilation, and worked with the CEC to provide schools tools and information to install, commission, and maintain systems appropriately. In phase 2, researchers installed and commissioned 2 next-generation HVAC systems on 2 schools. In phase 3, the team conducted simulation for schools built in 1998 and 2008. Results show energy savings and IAQ improvements from new HVAC systems. Use of high efficiency air filters significantly decreased PM2.5 levels without significant increase in ventilation energy. Researchers worked with manufacturers to fix issues with the new systems such as additional standby power consumption.
EPC-15-034 Emerging Energy Public Health Research Roadmap	Pre-existing intellectual property identified in agreement EPC-15-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Public Health Institute	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This report establishes a public health research roadmap aimed at anticipating and preventing potential unintended health impacts of emerging electricity generating, storing, and distributing systems (EES). Research recommendations were prioritized and presented in this roadmap.	4b, 5d	In 2017, the research team held 22 meetings with 34 experts throughout the energy, life cycle assessment, health, labor, and environmental justice field for total for over 30 hours. The team also created a growing database of peer-reviewed and grey literature. As of December 2017, the database houses 165 documents on Emerging Electricity-Generating Systems and related health and equity topics. Workshops were conducted in spring and summer of 2017 to obtain inputs. The research roadmap was published in fall 2017.
EPC-15-035 Clarifying and Quantifying Current and Near-Term Groundwater Pumping Energy Use and Costs in California to Improve Energy and Water Systems Reliability	Pre-existing intellectual property identified in agreement EPC-15-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Lawrence Berkeley National Laboratory	Group 7: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This study is quantifying current and near-term statewide energy use and costs due to groundwater pumping. Previous estimates of energy use for groundwater pumping likely underestimated the amount of energy used because of a lack of information on actual groundwater use. Due to recent regulatory changes, the availability of information on groundwater use has increased significantly. This information, combined with high resolution modeling of hydrologic and climate change effects, will allow the researchers to produce more accurate estimates of current and future energy used for groundwater pumping. Benefits from this study will enable entities, such as investor owned utilities, water agencies, and others, to increase the efficiency of the energy used in the water sector, inform demand side management strategies, and decrease greenhouse gas emissions.	1f, 2a, 4c	This project was completed in 2019. The researchers found that, due to a warming climate, after 2050 there would be a significant increase in groundwater pumping and associated electricity use; some regions will experience a significant increase in groundwater use, such as a 42 percent increase in the Sacramento area by 2050, while other areas will have smaller increases. The researchers also conducted a survey of municipal and agricultural groundwater users to identify barriers to reducing energy used for groundwater pumping. The identified barriers include high initial capital investment, the availability of other more cost-effective operational measures, and the administrative and time intensity burden of incentive programs. The final report for this project is in preparation.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-036 Probabilistic Seasonal and Decadal Forecasts for the Electricity System Using Linear Inverse Modeling	Applied Research and Development	This project made three primary climate data advancements: (1) developed a curated, quality-controlled repository of hourly weather observations at 39 locations across California for the period 1973-2019, (2) provided recommendations for how to best use the data and supporting documentation, and (3) offered guidance on hosting a periodically updated database of quality-controlled, hourly temperature observations on Cal-Adapt. Data products utilized in this work supported development of a statewide data repository, providing energy sector stakeholders with regular ultra-high resolution data products that are needed to help California meet its renewable energy and climate goals. Additionally, the project assessed and quantified the extent to which the state of the Pacific Ocean can be used as a basis for generating predictions of temperature in California. The project then outlined an approach for making such predictions operational. The data and analyses produced and performed in this project meet the stated needs of investor-owned utilities, publicly-owned utilities, and state agencies to provide insight into the effects of sub-daily weather on the electrical system.	4/13/2016	No	Grid Operations/ Market Design	$400,000	$400,000	$399,999	N/A	$399,999	$26,898	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-037 Smart Ventilation for Advanced California Homes	Applied Research and Development	This study explores how real-time monitoring and automatic controls can be used in home ventilation systems to improve energy efficiency and/or optimize consumption for time of day load balancing. Specifically, the study considers optimization of ventilation for indoor air quality for zones (i.e., air quality in different rooms within buildings). The study is being done via software simulation, in multiple well-established platforms, to develop and evaluate control schemes for home ventilation systems. Key evaluation criteria are the modeled ventilation-related energy used over a year of operation, and the IAQ relative to a minimally code-compliant continuously operating ventilation system.	4/13/2016	No	Distribution	$1,500,000	$1,500,000	$1,500,000	N/A	$1,500,000	$649,037	$1,000,000	Lawrence Berkeley National Laboratory; United States Department of Energy; Aereco S.A.	$1,300,000	46.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-038 ** BlueTechValley Innovation Cluster	Applied Research and Development	This project expands access for clean energy entrepreneurs to a region-wide energy-water-food nexus incubator and commercialization services in California's Central Valley and North State regions. The Central Valley Energy Innovation Cluster (a.k.a. BlueTech Valley Energy Cluster) provides entrepreneurs with a variety of services, including technology evaluation, proof-of-concept validation and advisory support as well as opportunities to connect with investors, industry leaders and potential customers.	4/13/2016	No	Demand-side Management	$3,000,000	$3,000,000	$1,819,852	N/A	$1,819,852	$718,347	$800,000	Schatz Energy Research Center; California State University, Fresno Foundation; Los Angeles Cleantech Incubator; Kern Economic Development Corporation; Child Family Institute for Innovation and Entrepreneurship - UC Davis	$2,655,684	34.7%	Grant

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EPC-15-036 Probabilistic Seasonal and Decadal Forecasts for the Electricity System Using Linear Inverse Modeling	Pre-existing intellectual property identified in agreement EPC-15-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Eagle Rock Analytics	Group 10: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Investor-owned utilities and the CEC's demand forecasting group have historically utilized daily climate information to assess and plan for use response to weather. As the share of power provided by intermittent renewable generation increases, and in tandem with the increasing availability of per-user sub-daily user consumption data, sub-daily weather information is increasingly necessary. This work provides a stable quality-controlled record curated for California's energy sector. Providing this information to energy system stakeholders through Cal-Adapt will facilitate a more stable energy system for California ratepayers, by (1) allowing utilities to better understand how diurnal weather variability and electricity use are related and (2) by providing for a centralized, publicly-available, regularly-updated database of quality-controlled data to be hosted on the Cal-Adapt platform.	5c	In 2019, the research team improved and optimized forecasting algorithms; processed and analyzed hourly weather data for trends and relevant quantities; reviewed peer-reviewed atmospheric science literature to identify additional determinants of predictability in seasonal temperature; produced and uploaded datasets for use by the CEC's Demand Analysis Office, the Cal-Adapt development team, and other energy sector stakeholders; and participated in a final meeting in which technical results were shared with the Demand Forecast Office. Finally, the research team submitted a final report for publication, began work on a peer-reviewed publication, and participated in knowledge transfer to support a workshop where hourly data will be discussed by IOUs, CEC, CPUC, and other energy sector stakeholders to illuminate how best to provide access to the data on Cal-Adapt.
EPC-15-037 Smart Ventilation for Advanced California Homes	Pre-existing intellectual property identified in agreement EPC-15-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This work builds on efforts of the past decade that have facilitated dynamic ventilation approaches. The project uses informed simulation approaches to determine how energy, IAQ, demand, and comfort can be optimized using smart ventilation. The results from the project will help smart home automation service providers and their consumers identify effective smart ventilation strategies and provide important, as well as provide information that the Energy Commission could potentially use in development of future ventilation standards.	4b, 5d	The project team completed several journal publications based on literature review and developed guidelines for IAQ metrics. Metrics have now been used in a U.S. Department of Energy (DOE) project in the development of a home IAQ scoring system. Key technical work for this project is to develop an integrated energy simulation model that includes smart ventilation technology. The simulation work is ongoing. The team also developed a range of optimized control algorithms for various home ventilation scenarios based on occupancy, timers, and weather conditions. The integrated simulation model includes both an air flow and contaminant transport model,"CONTAM" managed by the National Institute of Standards and Technology and a building energy model, "EnergyPlus" managed by DOE. Residential building types used in the models were represented as compliant with California Energy Code.
EPC-15-038 ** BlueTechValley Innovation Cluster	Pre-existing intellectual property identified in agreement EPC-15-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	California State University, Fresno Foundation	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will help lead to technology advancements by providing and coordinating key services, assistance, resources, and infrastructure needed by entrepreneurs and researchers to create and develop advanced energy technologies that will help the state meet the targets set by Senate Bill 350 to increase both renewable electricity generation and energy efficiency to 50 percent by 2030.	2a, 3e	BlueTechValley (BTV) has accepted and supported 179 companies (66 companies in 2019) which received $8.2 million in follow-on private capital and $4.85 million in follow-on public funding in 2019. To date, BTV companies have received $36.4 million in follow-on private capital and $13.14 million in follow-on public funding. BTV hosted or supported over 50 events in 2019 to support entrepreneurs including grant-writing workshops, CEO Crash Course Boot Camps and the Central Valley Clean Tech Showcase. In 2020, outreach activities will focus on four key areas: 1) work with each Hub to identify and conduct events throughout the region on funding, product design, business development and industry trends; 2) build regional connections with entrepreneurial, community and research organizations; 3) conduct a major energy conference in spring 2020; and 4) expand program resources through each Hub.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-038 ** BlueTechValley Innovation Cluster	Market Facilitation	This project expands access for clean energy entrepreneurs to a region-wide energy-water-food nexus incubator and commercialization services in California's Central Valley and North State regions. The Central Valley Energy Innovation Cluster (a.k.a. BlueTech Valley Energy Cluster) provides entrepreneurs with a variety of services, including technology evaluation, proof-of-concept validation and advisory support as well as opportunities to connect with investors, industry leaders and potential customers.	4/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-039 Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle	Applied Research and Development	This project installs soil and meteorological sensors at sites with solar installations and in adjacent undisturbed areas to make direct comparisons on the gains or losses of carbon, changes in microclimate and hydrology, and changes in dust generation or capture, and is aiming to predict long term soil and GHG emissions changes based on geochemical modeling. The project addresses the question of whether land alteration and modification during the construction and use of solar installations has a measurable impact on the soil carbon balance, and ultimately on the net carbon savings that solar installations provide during their lifetime.	4/13/2016	No	Generation	$499,181	$499,181	$31,720	N/A	$31,720	$80,312	$0	The Regents of the University of California, Berkeley	$72,000	12.6%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-040 Assessing California's Mitigation Guidelines for Burrowing Owls Impacted by Renewable Energy	Applied Research and Development	The project analyzed the consequences of both passive and active relocation methods for burrowing owls (a California Species of Special Concern), and filled an existing need for robust scientific data on the relative effectiveness of relocation as a conservation method. Secondary goals were to provide data on owl movements and habitat use that could inform collision risk models and site selection decisions for renewable energy-generating facilities. The project team fit more than 50 owls with GPS tracking devices and divided them into three study groups--active translocation, passive relocation, and a control group. Frequent site visits provided information on mortality rates and reproductive output.	5/17/2016	No	Generation	$598,671	$598,671	$440,675	N/A	$440,675	$54,425	$0	United States Department Fish and Wildlife Service; Zoological Society of San Diego dba San Diego Zoo Global; Western Riverside County Regional Conservation Authority; Coachella Valley Conservation Commission	$602,936	50.2%	Grant

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EPC-15-038 ** BlueTechValley Innovation Cluster	Pre-existing intellectual property identified in agreement EPC-15-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	6 out of 12 bidders	California State University, Fresno Foundation	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will help lead to technology advancements by providing and coordinating key services, assistance, resources, and infrastructure needed by entrepreneurs and researchers to create and develop advanced energy technologies that will help the state meet the targets set by Senate Bill 350 to increase both renewable electricity generation and energy efficiency to 50 percent by 2030.	2a, 3e	BlueTechValley (BTV) has accepted and supported 179 companies (66 companies in 2019) which received $8.2 million in follow-on private capital and $4.85 million in follow-on public funding in 2019. To date, BTV companies have received $36.4 million in follow-on private capital and $13.14 million in follow-on public funding. BTV hosted or supported over 50 events in 2019 to support entrepreneurs including grant-writing workshops, CEO Crash Course Boot Camps and the Central Valley Clean Tech Showcase. In 2020, outreach activities will focus on four key areas: 1) work with each Hub to identify and conduct events throughout the region on funding, product design, business development and industry trends; 2) build regional connections with entrepreneurial, community and research organizations; 3) conduct a major energy conference in spring 2020; and 4) expand program resources through each Hub.
EPC-15-039 Carbon Balance with Renewable Energy: Effects of Solar Installations on Desert Soil Carbon Cycle	Pre-existing intellectual property identified in agreement EPC-15-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Berkeley	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The research project -- the first of its kind -- is determining the impact of large solar arrays on the carbon storage of desert soil ecosystems. Findings will provide insights into the most effective ways to design and manage solar production facilities for maximum net carbon benefits.	2a, 4f	The research team has been continuously collecting tropospheric climate and physical and biological soil data at six undisturbed sites within the Mojave National Preserve. Chemical, physical, and organic and inorganic carbon measurements have been completed on all soil samples collected from undisturbed site. Data from the sites has been used to parameterize the DayCent ecosystem process model. Installation and sampling of two in-situ monitoring stations located at a utility-scale solar facility was completed in 2018. Data collection of temperature, water content, and corresponding CO2 concentrations continued through 2019. The team will continue field data analyses, associated geochemical modeling, and radiocarbon interpretations to evaluate short and long-term impacts of land use and climate change on the soil carbon cycle. The final report will be submitted in December 2019.
EPC-15-040 Assessing California's Mitigation Guidelines for Burrowing Owls Impacted by Renewable Energy	Pre-existing intellectual property identified in agreement EPC-15-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Zoological Society of San Diego dba San Diego Zoo Global	Group 6: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on burrowing owls. This was achieved by evaluating the relative effectiveness of primary translocation methods in an experimental framework. Improvements to the effectiveness of existing translocation methods were tested experimentally. Long-term GPS tracking of individuals in the active and passive relocation groups and a control group provided the critical, previously missing, information to judge the effectiveness of each method. The management recommendations and proposed translocation protocols from this study should improve the success of mitigation and facilitate new permitting of renewable energy.	2a, 4f, 4g	The project was completed in 2019, and the final report was received. The researchers captured the targeted number of burrowing owls at development sites for three treatment groups. They released the active translocation group of owls at conservation areas and monitored their mortality and reproductive success. Short-term survival after translocation was relatively high, with no apparent reduction in reproduction. In collaboration with the Technical Advisory Committee, the project team refined the study design and research protocols and made recommendations to wildlife regulatory agencies about translocation protocols. In addition, they tested GPS units and modified their design for use with burrowing owls. The team shared sample material from captured owls with researchers in EPC-14-061 and EPC-15-043 to extend the data used for isotopic and genetic analyses in those projects.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-041 MarketZero: Taking an existing grocery store to scalable near-ZNE	Technology Demonstration and Deployment	The project implements a cost-effective energy efficiency upgrade package for a grocery store that uses both mature and innovative energy efficiency technologies. The project includes LED lighting and refrigeration system improvements to increase energy efficiency, changing to a lower global warming potential refrigerant (R448A), and installing high-efficiency variable frequency drive compressors. Other improvements include thermal ice packs in the walk-in freezers to reduce compressor run time during the day and help shift electrical load on hot days, variable speed reluctance motors for the supply fans for new efficient heat pumps, and self-contained refrigeration cases to improve the efficiency.	4/13/2016	No	Demand-side Management	$2,999,591	$2,999,591	$1,346,168	N/A	$1,346,168	$846,723	$0	Whole Foods Market	$650,000	17.8%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-042 Zero Energy Residential Optimization - Community Achievement (ZERO-CA)	Technology Demonstration and Deployment	The project serves as proof of concept for large-scale deployment of Zero Net Energy (ZNE) single-family homes in California. The objective is to construct ZNE homes without creating undue cost burdens on builders, businesses or consumers, while assuring that changes to home design do not pose health, safety or other risks to occupants. The project also provides industry and regulators with a better understanding of site energy use and renewable energy generation.	5/17/2016	No	Demand-side Management	$4,819,805	$4,819,805	$2,063,803	N/A	$2,063,803	$1,488,701	$0	California Homebuilding Foundation (CHF)	$2,611,014	35.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-043 Development of a Genoscape Framework for Assessing Population-Level Impacts of Renewable Energy Development on Migratory Bird Species in California	Applied Research and Development	This project developed a low-cost method to create high-resolution spatial maps of bird populations and migration routes that capitalizes on genomic data. This technology was extended to identify migration routes for additional vulnerable and endangered species, assess population-level impacts of fatalities at renewable energy facilities, and map migration hotspots. This information can help with siting decisions of new facilities as well as operational decisions, such as when to turn off wind turbines to avoid vulnerable population fatalities, reducing the overall number of bird losses at renewable energy facilities. Accurate understanding of the distributions of vulnerable populations in space and time will lead to more effective siting, monitoring, and operation, ultimately lowering costs to California ratepayers.	4/13/2016	No	Generation	$599,236	$599,236	$532,742	N/A	$532,742	$114,848	$299,316	Regents of the University of California, Los Angeles	$888,250	59.7%	Grant

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EPC-15-041 MarketZero: Taking an existing grocery store to scalable near-ZNE	Pre-existing intellectual property identified in agreement EPC-15-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Prospect Silicon Valley	Group 5: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	As grocery store owners are risk averse especially with new emerging innovative technologies, successful demonstration showing the benefits and performance of an all-electric grocery store, could advance these technologies for use in other grocery stores. As profit margins for grocery stores are between 1 and 3 percent, increases in energy efficiency using these advanced technologies will be beneficial to a store's bottom line. Also, these types of improvements pose challenges to grocery stores due to limited space and existing configurations. However, documenting cost, savings and benefits could influence the grocery market to make similar future upgrades. These solutions and design approaches hope to reduce greenhouse gas emissions and decarbonize grocery stores.	1e, 1f, 1h, 4a	All projects are installed and now being monitored. The demonstration site is Whole Foods in San Francisco. The store will install a sound barrier to address sound levels from the new Daikin VRF system. SMC Motors are having controllers programmed for the reluctance motors. These motors work with the supply air on the new heat pumps. Draft final report being written.
EPC-15-042 Zero Energy Residential Optimization - Community Achievement (ZERO-CA)	Pre-existing intellectual property identified in agreement EPC-15-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	California Homebuilding Foundation (CHF)	Group 6: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Working closely with the builder and subcontractors, technology costs will be evaluated and will include a real-world perspective by providing actual time and labor spent to install and commission each of the new technologies versus only the technology cost. By providing this data and analysis on up to 50 homes being constructed, this project will serve as a roadmap toward the most effective ways to implement ZNE homes. The information gathered will be disseminated through various project participants such as California Building Industry Association (CBIA) events and member newsletters in efforts to promote the potential for cost-effective ZNE to the builder community.	1f, 1h, 3b, 4a	The project continues to construct and sell ZNE Homes. The Recipient is in the process of drafting the ZNE construction report. A working group design charrette was held in late February to feed into the content of the ZNE construction report. A small subset of homes (10-15) have begun monitoring and data collection activities. Work is ongoing to analyze the preliminary data sets.
EPC-15-043 Development of a Genoscape Framework for Assessing Population-Level Impacts of Renewable Energy Development on Migratory Bird Species in California	Pre-existing intellectual property identified in agreement EPC-15-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Regents of the University of California, Los Angeles	Group 6: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project harnessed the power of genomic data to develop genetic assays for quick, low-cost screening of thousands of individual birds. Researchers created high-resolution maps of population structure and migration routes and applied this information to assess population-level impacts by screening carcasses collected from renewable energy facilities. Genoscape maps were merged with existing spatial data of energy potential to make recommendations for siting new facilities in areas with minimal impact on wildlife.	2a, 4g	The project was completed in 2019, and the final report was received. The researchers developed maps and schedules of the migration routes (genoscape maps) of distinct populations of four birds (Common Yellowthroats, Wilson's Warbler, Burrowing Owls, and American Kestrel) relative to renewable energy sites. Samples from bird carcasses killed at solar and wind facilities were assessed by the genetic methods to estimate the population-level effects. The results support the idea that the majority of individuals exposed to renewable energy development were from the largest genetically distinct populations within each species, whereas carcasses from rare and declining populations made up a smaller percentage of the total number of birds sampled. Prioritization of renewable energy siting varied by the taxonomic groups. Multiple journal articles are being written.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-044 Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources	Applied Research and Development	This project developed two key open-source software technologies: 1) implementation of a complete, certified IEEE 2030.5 communication protocol that manufacturers can freely incorporate into their products. This reduces the cost and complexity of bringing systems to market, streamlines the certification process, and helps ensure that products can successfully connect and participate in grid programs; and 2) a certification procedure and associated test software by which any system or device can be checked for compliance to the standard. Independent evaluation provides manufacturers with an unbiased assessment of their products and provides both business and individual consumers with assurance that their purchases will work as expected. The project also validated the completeness and quality of these technologies by implementing the open-source client in a commercial DER system and performing field testing.	5/17/2016	No	Distribution	$816,539	$816,539	$806,503	N/A	$806,503	$203,973	$0	Electric Power Research Institute, Inc.; Xanthus Consulting International; SunSpec Alliance; Enphase Energy; QualityLogic	$243,722	23.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-045 Transactive Incentive Signals to Manage Electricity Consumption for Demand Response	Applied Research and Development	This project develops Transactive Load Management (TLM) signals, expressed in the form of proxy prices reflective of current and future grid conditions, and develops and implements software to calculate such signals. These signals are being designed to provide customers sufficient information to optimize their energy costs by managing their demand in response to system needs. The signals are transported via proven and available protocols and networks for use by projects that will test the efficacy of the TLM signals using the demand response projects awarded under GFO-15-311, Advancing Solutions that allow Customers to Manage Their Energy Demand.	5/17/2016	No	Grid Operations/ Market Design	$498,054	$498,054	$443,169	N/A	$443,169	$190,201	$0	Greenlots	$110,450	18.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-046 Developing a Distribution Substation Management System	Applied Research and Development	This project developed a software which can display the current state of the distribution system, detect problems, and automatically suggest potential solutions to reduce outage times. The software also helps automate routine and non-routine engineering and maintenance tasks that are performed on substation equipment, such as monitoring voltage violation.	5/17/2016	No	Distribution	$500,000	$500,000	$499,999	N/A	$499,999	$171,526	$0	Siemens Corporation, Corporate Technology	$455,000	47.6%	Grant

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EPC-15-044 Certified Open-Source Software to Support the Interconnection Compliance of Distributed Energy Resources	Pre-existing intellectual property identified in agreement EPC-15-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project helps accelerate availability and connection of DER products and systems in California that meet Rule 21 requirements. This also helps more rapidly increase grid-tied solar generation to meet California's aggressive solar mandates.	1a, 1h, 1i, 2a, 3a, 5a	The project completed in March 2019. The final report "Certified Open Source Software to Support the Interconnection Compliance of Distributed Energy Resources" was received. Four different product vendors have implemented the open sourced IEEE 2030.5 client. The software integrates with their commercial gateways, or facility energy management systems to provide a Rule 21 compliant interface to utility operations. Several others are currently testing the viability of incorporating the open source software in their products.
EPC-15-045 Transactive Incentive Signals to Manage Electricity Consumption for Demand Response	Pre-existing intellectual property identified in agreement EPC-15-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Electric Power Research Institute, Inc.	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project has developed a day-ahead hourly proxy price signal that incorporates system conditions as reflected by wholesale energy markets. The hourly prices are being made available on a publicly-accessible server and are being incorporated as one of the experimental pricing structures being evaluated in EPIC demand response projects funded under GFO-15-311 in order to assess the potential for a variety of different loads and customer types to respond automatically to a real-time proxy pricing signal, and by extension, the potential of DR being a demand side or a supply side resource for the State.	1c, 1d, 1e, 1f, 1g, 1h, 3c, 3e, 3f, 3h, 4a, 5a, 5b	This project has completed all technical deliverables. The agreement was extended to March 31, 2020 to allow the recipient to continue to support the Transactive Load Management signal for use by the other agreements awarded under GFO-15-311.
EPC-15-046 Developing a Distribution Substation Management System	Pre-existing intellectual property identified in agreement EPC-15-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Siemens Corporation, Corporate Technology	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	Highly automated and efficient grid operation is required to achieve California's energy goals, in particular with respect to the Clean Energy and Pollution Reduction Act of 2015 (Senate Bill 350) that strives to reach 50 percent renewable energy resources. This project can lead to technological advancement and breakthroughs to overcome barriers in electrical grid automation by demonstrating the potential of semantic technologies for categorizing and processing data, as well as for discovering relationships within a varied data set. This system allows operators to control and further automate routine and non-routine engineering and maintenance tasks that are performed on substations. By making the complex smart grid more accessible for operators, it permits faster resolution of outages, thereby making the grid more maintainable and resilient.	3a, 3d, 5f, 5h	The project completed in March 2019. The final report, "A Semantically Integrated Operational Dashboard for the Management of Smart Grid" was received. The Siemens Corporate Technology team is actively looking for partners within Siemens and the utilities in California to run a pilot project to conduct user studies of the developed dashboards with grid operators.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-047 Powernet - A Cloud Based Method for Managing Distribution Resources	Applied Research and Development	This project will further develop Powernet, a cloud-based platform for managing energy resources in homes and businesses. Powernet will control and coordinate energy resources both behind the meter and at the distribution system for residential and commercial ratepayers to: (i) minimize costs, (ii) increase consumer quality of service, (iii) preserve grid stability and (iv) offer services to the grid.	5/17/2016	No	Distribution	$2,210,720	$2,210,720	$2,210,720	N/A	$2,210,720	$865,939	$3,500,000	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-048 Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources	Applied Research and Development	This project tests and validates an intelligent residential energy management system that is capable of communicating with a variety of distributed energy resources (DER) including solar PV and energy storage in 100 residences in San Diego. The project integrates the use of pilot time-of-use utility rates in conjunction with simulated dynamic pricing signals to optimize grid impact and cost savings.	5/17/2016	No	Demand-side Management	$3,996,560	$3,996,560	$3,258,017	N/A	$3,258,017	$637,870	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-049 Electricity Pumped Storage Systems Using Underground Reservoirs: A Feasibility Study for the Antelope Valley Water Storage System	Applied Research and Development	The project conducts a feasibility study that determines the value of energy storage and associated grid support benefits provided by Peak Hour Pumped Storage and Aquifer Pumped Hydro applications at an existing water bank. The feasibility study also identifies critical parameters for success for both technologies and identifies other water banking sites in the state where these technologies are likely to be successful.	5/17/2016	No	Generation	$197,300	$197,300	$136,796	N/A	$136,796	$15,276	$0	CIM Group	$199,353	50.3%	Grant

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EPC-15-047 Powernet - A Cloud Based Method for Managing Distribution Resources	Pre-existing intellectual property identified in agreement EPC-15-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	SLAC National Accelerator Laboratory	Group 2: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Several significant Powernet system innovations will be developed under this agreement: (i) The integration of control, optimization and power electronics will enable novel functionality that includes stable connect/disconnect from the grid, local and global power sharing, and grid services including demand response; (ii) The layered structure of the system will enable the operator to utilize Powernet for a variety of different grid purposes or service offerings with the assurance that those are always done on top of an economically optimal operating point every second; (iii) The system will be robust and secure by design; and (iv) The system will adopt open source standards and protocols for the platform to enable scalable engagement of devices in the future.	1g, 2a, 3a, 3d, 3f, 5f, 5h	The project team continues to make progress on the project deliverables and installation of batteries, inverters, charging stations, rooftop solar, and metering equipment. The Deployment Report was submitted in August which covered customer recruitment, permitting, test simulations, and final implementation. Equipment was installed at 11 residential homes in the City of Fremont. The recipient submitted the draft final report in October, ahead of the projected November deadline.
EPC-15-048 Residential Intelligent Energy Management Solution: Advanced Intelligence to Enable Integration of Distributed Energy Resources	Pre-existing intellectual property identified in agreement EPC-15-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Alternative Energy Systems Consulting, Inc.	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The key advancement in this project will be the operational integration strategies being developed and tested in the field. If proven successful through field testing, this system has the potential of achieving widespread deployment throughout the state which could significantly reduce peak demand, reduce annual energy costs, and improve grid operations.	1e, 1h, 2a, 4a	Progress this year includes completing installations with all equipment operating and collecting data, completed production readiness plan, technology/knowledge transfer plan, and draft final report. Project team continues to analyze field test data.
EPC-15-049 Electricity Pumped Storage Systems Using Underground Reservoirs: A Feasibility Study for the Antelope Valley Water Storage System	Pre-existing intellectual property identified in agreement EPC-15-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Antelope Valley Water Storage, LLC	Group 11: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project conducts feasibility analyses of Aquifer Pumped Hydro and Peak Hour Pumped Storage for energy storage purposes, hydropower generation, and demand response potential if implemented at a groundwater bank. Potential barriers are identified and economic analysis conducted to identify types of implementation with the highest value. The project is developing a set of tools other water banks can use to conduct similar assessments. Based on preliminary review, these tools could be very useful for all water banks in California.	1e, 3f	The research team conducted technical feasibility analysis and preliminary field testing of two pumped storage systems: Peak Hour Pumped Storage (PHPS) and Aquifer Pumped Hydro (APH) storage at Willow Spring Water Bank. Hydropower generation and demand response potential of groundwater banking projects were assessed. The results show low efficiency and revealed water quality issues as a potential barrier for implementation for the APH system. The demand response during a dry hydrologic year has the highest value based on analysis. The project also created tools for other groundwater banks in California to conduct similar analysis. The project was completed as planned in September 2017 and the final report is published.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-050 Winery Water and Energy Savings	Technology Demonstration and Deployment	This project is testing two energy and water saving technologies at a winery facility in northern California. The first technology is a water treatment and reuse system to recycle wastewater for indoor barrel washing. The second is a wine-to-wine heat exchanger for the cold-stabilization process -- a process through which white wine is cooled to a low 28 degree Fahrenheit and then heated back up to 55 degree Fahrenheit. Both technologies are to be installed on a single skid at the project location in Sonoma County, along with monitoring and verification equipment. Jackson Family Wines owns the bottling facility where the technologies are being tested.	5/17/2016	No	Demand-side Management	$1,989,201	$1,989,201	$1,460,207	N/A	$1,460,207	$157,088	$0	Jackson Family Wines	$404,625	16.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-051 The Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings	Applied Research and Development	This project identifies, quantifies and evaluates the incremental costs and benefits of demand responsive (DR) lighting controls system requirements in the California Energy Code across existing, non-residential building stock. The project focuses on the incremental costs and benefits associated with adding the DR functionality to enhance general lighting upgrades in existing, non-residential buildings to enable them to act as DR resources.	5/17/2016	No	Demand-side Management	$500,000	$500,000	$500,000	N/A	$500,000	$130,529	$0	Energy Solutions	$138,648	21.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-053 Customer-Centric Approach to Scaling IDSM Retrofits	Technology Demonstration and Deployment	This project develops and demonstrates an approach to scale residential retrofits for disadvantaged communities that will focus on customer-centric solutions. This project develops and demonstrates an innovative approach, focusing on energy efficient integrated demand side management (IDSM) retrofit packages that are non-intrusive to occupants and have the potential of reducing energy use by 30 to 40 percent.	5/17/2016	No	Demand-side Management	$3,894,721	$3,894,721	$2,386,045	N/A	$2,386,045	$1,382,796	$0	Southern California Edison; BIRA Energy; LINC Housing Corporation	$799,559	17.0%	Grant

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EPC-15-050 Winery Water and Energy Savings	Pre-existing intellectual property identified in agreement EPC-15-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Regents of the University of California, Davis	Group 2: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	The project focuses on full-scale technology demonstrations of two water and energy saving technologies for the wine industry. The water treatment and reuse system uses reverse osmosis to treat water to potable standards for barrel washing with an estimated water savings of 90 percent at the facility. This technology is in use in alternative markets, but not at wineries. The second technology is an innovative wine-to-wine heat exchanger for the cold-stabilization of the white wine that reutilizes the thermal potential of existing cooling and heating streams which reduces the amount of energy used for processing white wine. Cold stabilization process is one of the most energy intensive processes in the wine industry and one that could significantly benefit from the simple wine-to-wine heat exchanger technology.	1f, 1h, 2a, 4a, 4c	Three quarterly measurement and verification (M&V) reports were submitted and the fourth (final) report is being finalized. The third quarterly M&V report identified the to-date operation and performance of the two water and energy saving technologies deployed and demonstrated at the Jackson Family Wines facility. Each technology presented unique opportunities for savings. The water treatment and reuse system (VSEP) yielded about 68% water recovery from the raw influent. Moving forward, formal optimization procedures may result in even higher percent recovery of water. The second technology, the wine-to-wine heat exchanger system, was able to reduce energy costs by 88-98% and has shown that it is capable of operating within the required performance specifications.
EPC-15-051 The Value Proposition for Cost-Effective, DR-Enabling, Nonresidential Lighting System Retrofits in California Buildings	Pre-existing intellectual property identified in agreement EPC-15-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Lawrence Berkeley National Laboratory	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will advance intelligent, network controls to become dynamically controlled, dispatchable grid resources. The advanced controls developed will ease building participation in Auto-Demand Response (DR) programs and improve grid reliability and resiliency, improve user interfaces for lighting systems to reduce energy waste and cost, and enable IOUs and others to geographically target DR deployments as a cost effective means to transmission and distribution infrastructure upgrades.	1e, 1f, 1h, 5b	The project is complete. Research results indicate that networked lighting control systems will become an important distributed energy resource (DER) because it increases lighting system efficiency, flexible control and rapid-response capabilities, and eases load aggregation. As more facilities recognize the non-energy benefits of net worked lighting control systems, these systems are expected to see increased market adoption along with decreased prices. Additionally, as the electricity market becomes more volatile, these systems could help with grid balancing and stabilization. The final report will be published in January 2019.
EPC-15-053 Customer-Centric Approach to Scaling IDSM Retrofits	Pre-existing intellectual property identified in agreement EPC-15-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Electric Power Research Institute, Inc.	Group 5: Ranked # 3	N/A	N/A	No	The project provides new data, analysis, and designs for cost-effective integrated demand side management retrofits that addresses some of the infrastructure challenges with existing multifamily buildings. The recipient has identified advanced technologies associated with HVAC and water heating that hope to overcome the infrastructure challenges, along with other innovations including smart thermostats, plug load controls, and LED lighting. The project results and monitoring and verification data will determine whether these portfolio of projects can achieve the goal of 30-40% reduction in energy use while minimizing tenant disruptions.	1f, 1h, 4a, 5b	This project has two demonstration sites. In Ontario: The research team has completed obtained 12+ months of post-retrofit data. The preliminary results show reduced electricity use after installation of high efficiency heat pumps and insulated roofs. In Fresno: Site installation is delayed due to the lack of technologies that are able to support the existing electrical infrastructure. The research team has identified a 110V HVAC heat pump from Europe and a community heat pump watering system. The heat pump water heaters will consist of one large tank and heat pump per building that will service existing pipes and tanks of the residential units.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-054 Complete and Low Cost Retail Automated Transactive Energy System (RATES)	Applied Research and Development	This project will develop and pilot-test a standards-based Retail Automated Transactive Energy System (RATES), and behind the meter energy management solution. The purpose is to minimize the cost and complexity of customer participation in energy efficiency programs, maximize the potential of small loads to improve system load factor, shave peaks, integrate renewable generation, and provide low opportunity-cost resources to the grid. This project will work with Southern California Edison to facilitate customer participation and expand Demand Response Participation in the area served the Moorpark substation.	5/17/2016	No	Demand-side Management	$3,187,370	$3,187,370	$3,185,294	N/A	$3,185,294	$0	$0	Universal Devices, Inc.; TBD - Controls; TBD Electrical Contractor; TeMix, Inc.	$1,087,710	25.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-055 The Charge Bliss Advanced Renewable Energy Community for a Disadvantaged Southern California Community	Market Facilitation	This project demonstrated how the City of Carson's disadvantaged downtown community could plan and design an advanced energy community that included an extensive electric vehicle charging network, high penetrations of photovoltaic (PV) generation, and stationary battery storage in their municipal parks and city-owned facilities. The project team used transportation and utility data to develop a plan for where to place EV charging stations within areas with high electric grid congestion and how the associated increased energy demand could be balanced with solar and storage to minimize grid impacts. The team conducted planning, permitting, financial modeling, and engineering design for over three megawatts of PVs and 40+ charging stations for a disadvantaged public sector and commercial area in the City of Carson. Charge Bliss collaborated with two local government entities, South Bay Cities Council of Governments, and Southern California Association of Governments, as well as a collection of universities and private companies on this effort.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,469,125	N/A	$1,469,125	$197,815	$0	Efacec; Edward Kjaer; Ji Min; Tanner Engineering	$96,937	6.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-056 Peninsula Advanced Energy Community (PAEC)	Market Facilitation	Clean Coalition planned and designed a Solar Emergency Microgrid (SEM) for the southern portion of San Mateo County. The team developed several case studies to guide SEM site selection based on which services would be included and their implicit or minimum loads, facility type, interconnection options, resources available, proximity of the site to local hazards, and available financing options. The project team used the case studies to inform their work with the local planning and building departments to streamline zoning and engineering permitting for optimal SEM sites. To help incentivize microgrid investments, including for the project's SEM, the project team worked to establish a backup power valuation methodology to use in commercial applications.	5/17/2016	No	Demand-side Management	$1,318,997	$1,318,997	$1,256,872	N/A	$1,256,872	$312,711	$0	Natural Capitalism Solutions, dba Clean Coalition	$330,000	20.0%	Grant

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EPC-15-054 Complete and Low Cost Retail Automated Transactive Energy System (RATES)	Pre-existing intellectual property identified in agreement EPC-15-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Universal Devices, Inc.	Group 2: Ranked # 4	N/A	N/A	Yes; Small Business, Calif Based Entity	This project developed an energy management automation platform that allows customers to participate in Demand Response (DR) markets by providing them the means to pre-program their preferred operational settings for end-use devices such as thermostats, pool pumps, and battery storage under variable pricing conditions. The technology applied those preferences to automating real-time response to energy market and rate variations using off-the-shelf equipment and a two-way subscription tariff design that allows customers to consume when prices are low and conserve when prices are high, without the need for complicated measurement, verification, and baselines. SCE staff believes that the approach has value and has provided additional funding to continue technology development and pilot testing after the EPIC project term ended.	1c, 1e, 1f, 1g, 1h, 3f, 4a	The project has been completed. The level of engagement by utilities and other partners is expanding the project impacts beyond what was initially anticipated in the agreement. SCE provided additional funding to support expansion of the research in the Moorpark substation area (a disadvantaged community also at risk for reliability issues). In addition, Google has been working with the team to evaluate its Alexa technology as a platform for hosting the transactive client. Post-EPIC project demonstrations are underway and SCE has provided funding to expand the number of test sites and include battery storage in the pilot, as well as facilitating expanded participation in CAISO markets.
EPC-15-055 The Charge Bliss Advanced Renewable Energy Community for a Disadvantaged Southern California Community	Pre-existing intellectual property identified in agreement EPC-15-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Charge Bliss, Inc.	Group 4: Ranked # 3	N/A	N/A	Yes; Micro Business, Calif Based Entity	SB 350 (2015) sets a 50 percent renewable energy standard by 2030 and a doubling of energy efficiency savings in buildings by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project piloted innovative planning, permitting financing, and engineering approaches and tools to help improve the business case for IDER adoption at the community-scale.	3b, 3e	The project team worked with community, technical, and civic stakeholders to develop a plan that selected the best public buildings and parks to install energy storage, an extensive electric vehicle charging network, photovoltaic, and smart control technology -- keeping in mind impacts to the grid, ZNE status, and cost. After completing the engineering design documents, the complete package was submitted to Carson. However, as of the end of 2018 the city chose not to further peruse the proposed development. This project demonstrated that early and frequent engagement with the community and civic leadership is an important aspect for advanced energy community efforts to avoid delays and re-designs that may arise from issues such as the need to compensate for pre-existing community priorities a
EPC-15-056 Peninsula Advanced Energy Community (PAEC)	Pre-existing intellectual property identified in agreement EPC-15-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Natural Capitalism Solutions, dba Clean Coalition	Group 1: Ranked # 3	N/A	N/A	No	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments are playing a critical role in achieving this goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project is piloting innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in June 2018 and Clean Coalition submitted a finalized master community design and case study, including four SEM models for different sites located in a disadvantaged community. These models integrate solar PV, energy storage, and electric vehicle charging infrastructure (EVCI), to increase resiliency from power outages. The project team is still pursuing a plan to connect all four sites, and is working with PG&E on the design. Additionally, several tools were developed to overcome economic, policy, and technical barriers that hinder AEC development, which include a streamlined permitting tool, a solar siting survey, and an EVCI master plan. The recipient has updated the project-specific page on their website: "http://www.clean-coalition.org/our-work/peninsula-advanced-energy-community/"]http://www.clean-coalition.org/our-work/peninsula-advanced-energy-community/.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-057 Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings	Applied Research and Development	The purpose of this project is to improve small and large commercial customer participation in demand response programs by providing a cost-effective energy management system that allows a wide range of service offerings as well as effective and automated price-based management. The project will develop automated control systems capable of responding to dynamic pricing and program designs. Design improvements include: 1) receive price signals and evaluate energy demand; 2) enable heterogeneous customers to adapt to DR with individual preferences; 3) track, evaluate and control multiple devices; 4) interoperate with various building systems; 5) retain the electrical usage history of connected devices; 6) provide pricing based load management algorithms; 7) coordinate to maintain load diversity; 8) provide security; and 9) provide value by allowing customers to minimize the opportunity costs of participating by selecting the least-impactful load management strategy.	5/17/2016	No	Demand-side Management	$4,000,000	$4,000,000	$2,544,449	N/A	$2,544,449	$1,373,762	$0	Quantum Energy Services & Technologies, Inc. (DBA: QuEST); Siemens Corporation, Corporate Technology	$424,000	9.6%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-058 The Oakland EcoBlock - A Zero Net Energy, Low Water Use Retrofit Neighborhood Demonstration Project	Market Facilitation	This project developed a model for a residential block-scale retrofit development of an integrated energy system combining energy efficiency, renewable generation, and water conservation technologies, called the EcoBlock. The development of the energy and water system components of the model served as a case study to analyze different owner-operator, and financing structures that may be applicable to a residential community. This case study can help transform the EcoBlock model from a one-off demonstration to a sustainable and replicable model for the entire state. The City of Oakland will also use the EcoBlock model to develop new planning and permitting processes that can lower the time and cost of similar block-scale developments throughout the city.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,166,591	N/A	$1,166,591	$117,432	$0	The Regents of the University of California on behalf of the Berkeley campus; Rexel Foundation; Morgan, Lewis & Bockius LLP; Arnold & Porter LLP; Perkins Coie	$769,846	33.9%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-059 UniGen Smart System for Renewable Integration	Applied Research and Development	This project developed the UniGen Smart Software System, a control software capable of reducing the volatility of energy output from a combination of variable energy resources (VER). VER generation often deviates from forecasts and schedules because of variations in weather. This can be alleviated by a fast-acting control system that automatically compensates for deviations from projected generation using a dedicated mix of energy resources (e.g., a photovoltaic system and an energy storage system). Onset's UniGen control system couples these resources with a primary power plant using proprietary algorithms in a software application in real time so that the combined output corresponds to the committed output. Any deviation is solved at the project or distributed level, making it easier for the California Independent System Operator (CAISO) to manage grid performance	5/17/2016	No	Grid Operations/ Market Design	$638,993	$638,993	$630,853	N/A	$630,853	$0	$0	None	$0	0.0%	Grant

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EPC-15-057 Customer-controlled, Price-mediated, Automated Demand Response for Commercial Buildings	Pre-existing intellectual property identified in agreement EPC-15-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	The Regents of the University of California (CIEE)	Group 2: Ranked # 3	N/A	N/A	No	This project is developed an open source software solution that is combined with an open architecture enabling platform. The eXtensible Building Operating System (XBOS/DR) can interface with multiple hardware devices from different vendors as well as include software applications from various vendors. With its ability to create a virtual building management system for small commercial buildings by networking thermostats and other controllers, XBOS/DR can provide large and small commercial customers with a variety of choices for DR capability. The open architecture can foster technical innovation by third-party vendors and other manufacturers in providing energy services.	1c, 1e, 1g, 1h, 4a	The project is complete. The researchers successfully developed a cost-effective energy management system that allowed a wide range of service offerings as well as effective and automated price-based management. This is achieved by developing automated control systems capable of responding to dynamic pricing and program designs. Most buildings that installed networked thermostats showed modest savings of 7-9%. DR event testing across 13 buildings resulted in an average of daily savings of $5.53, and 21 kWh in energy savings, with as high as $31.68 and122.01 kWh. The near-term target market is research groups who need data for analytics. The mid-term target market are utility program designers and startup companies who need building and system data. The platform will continue to be used in additional research projects funded by NYSERDA and DOE.
EPC-15-058 The Oakland EcoBlock - A Zero Net Energy, Low Water Use Retrofit Neighborhood Demonstration Project	Pre-existing intellectual property identified in agreement EPC-15-058 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	The Regents of the University of California, Berkeley	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	SB 350 (De Leon, 2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Deploying customer-side of the meter technologies at scale will help meet this goal, but will require new innovations to how local jurisdictions design, plan, finance, and manage energy upgrades at the community level. This project is developing sustainable financing structures, clear owner-operator responsibilities, and streamlined planning and permitting processes, which are critical to successfully deploying community-scale energy retrofits throughout the state.	2a, 3b, 3e	The project team completed a Community-Scale Zero Net Energy Retrofit Master Plan that includes 27 houses and 2 multi-family buildings in Oakland. The plan features a DC solar, storage, EV microgrid; energy efficiency retrofits; hybrid AC/DC homes; and a house scale water efficiency systems. The planned systems are estimated to reduce block-wide CO2 emissions by about 65 percent, with near zero net energy reduction at the house scale. The project also identified Community Facilities Districts (CFD) as a viable mechanism for residents to collectively finance communal energy and water installations--both upfront capital and ongoing O&M costs--via assessments on property tax bills. The City of Oakland is using the results of this project to examine any needed changes to its planning or permitting policies to accommodate block-scale DER developments such as the EcoBlock.
EPC-15-059 UniGen Smart System for Renewable Integration	Pre-existing intellectual property identified in agreement EPC-15-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Onset, Inc.	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project developed a software control system that can help integrate large amounts of VERs envisioned by California's energy policy (i.e., 33 percent by 2020 and 60 percent by 2030) along with current generation to create a more stable system. This software control system simplifies the CAISO's energy balancing efforts.	1a, 1h, 2a, 3a, 5a	This project was completed in March 2019. The final report is in the publication process. This project conducted a feasibility study for the UniGen Renewable Integration platform, which allows VERs to be scheduled in the Day Ahead Market (DAM). Using the DAM, in conjunction with UniGen and VERs, allows for greater penetration of renewables and a pathway for California to meet the 60% RPS. Onset, now known as Unigen Resources, entered into a partnership with Marin Clean Energy to undertake a pilot project. This project represents the first step toward commercialization of the Unigen Smart System.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-060 Optimizing Solar Facility Configuration Effects on Habitat, Managed Plants, and Essential Species Interactions	Applied Research and Development	This research implemented field-based experiments to quantify how microhabitat conditions vary across solar energy facilities. It then examined how those variations in microhabitat affect rare plants, invasive plants, and sensitive insects. Researchers determined how habitat variation affects target plant species and their essential species interactions, including herbivory, predation, and pathogens. The results lead to a series of management recommendations for siting new renewable energy facilities and their operation.	5/17/2016	No	Generation	$597,865	$597,865	$504,773	N/A	$504,773	$99,801	$150,000	Regents of University of California, Davis; The Regents of the University of California, Santa Cruz	$103,297	14.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-061 Using Data-Driven Approaches to Design Advanced Energy Communities for Existing Buildings	Market Facilitation	This project funded the planning, permitting, and preliminary engineering needed for the integration of advanced energy technologies in a disadvantaged community. The final design provides locally generated, GHG-free electricity from community solar and storage to offset electricity consumption of participants who opt in to the program. The design also enables participants to benefit from savings resulting from various onsite retrofits that enable better energy efficiency, energy management, and demand response. Participants will pay back retrofit costs and cost of capital for solar and storage assets through an on-bill financing mechanism, including a first-of-its-kind virtual net metering tariff across multiple county-owned sites and residential buildings piloted by Los Angeles Community Choice Energy. The project team developed robust data evaluation methods using the LA County Energy Atlas to efficiently and effectively identify high-need customers and site locations and to optimize project design and financing features. More information can be found at the project website: https://www.advancedenergycommunity.org/	5/17/2016	No	Demand-side Management	$1,497,996	$1,497,996	$1,213,016	N/A	$1,213,016	$449,666	$0	Regents of the University of California, Los Angeles; Los Angeles County Office of Sustainability	$381,074	20.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-062 Robust, Low-Cost, Real-Time, NOx Sensor for Optimization of Dispatchable Distributed Generation Systems	Applied Research and Development	The project tested several recently developed sensors with the capability to detect low NOx levels generated by dispatchable generation systems, such as internal combustion engines and microturbines. The proposed solution offers a cost effective means to monitor the real time emissions of the system and information that can be used to optimize system performance and maintain low emissions.	5/17/2016	No	Generation	$200,000	$200,000	$199,270	N/A	$199,270	$53,531	$0	None	$0	0.0%	Grant

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EPC-15-060 Optimizing Solar Facility Configuration Effects on Habitat, Managed Plants, and Essential Species Interactions	Pre-existing intellectual property identified in agreement EPC-15-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Regents of the University of California, Davis	Group 6: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project provided methods to improve understanding of the environmental impacts of solar energy facilities caused by direct changes in microhabitat or by site preparation treatment. It also enhanced the ability to predict and overcome costly invasions of non-native plants. It is one of the few studies that has considered the effects on species interactions throughout the food web, rather than just the effects on a single species.	2a, 3a, 4f	The project was completed in 2019. The photovoltaic-annual plant experiment studied the effects of solar panels on microhabitat from the effects of shade and enhanced runoff and how those changes affect the growth, survival, and reproductive success of native and invasive species. The results indicate that solar energy development in the Mojave Desert may have adverse impacts on some desert plants and that the level of impact may be regulated, to some extent, by informed site preparation and management practices. The concentrating solar-milkweed experiment found that plant-conservation islands, known as halos, are effective for Mojave milkweed conservation and maintenance of Mojave milkweed-queen butterfly trophic interactions, whereas blading sites was not. Several journal papers are in preparation or review.
EPC-15-061 Using Data-Driven Approaches to Design Advanced Energy Communities for Existing Buildings	Pre-existing intellectual property identified in agreement EPC-15-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Regents of the University of California, Los Angeles	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Local governments can play a critical role in achieving the state's SB 350 (2015) building energy efficiency goals by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) for energy efficiency. This project is piloting innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in March 2018. The project has resulted in a shovel-ready AEC design in preparation for Phase II and has made several findings towards lowering barriers to access to energy efficiency and solar in local DACs. The implementation of a VNEM tariff was critical in showing financial viability of the design since it allows community members to share the benefits of local renewable power even if they cannot or prefer not to install solar panels and/or an energy storage system on their own property. The project team found that the existence of a Community Choice Aggregator (CCA) allows for streamlined deployment of a VNEM tariff, which may not be the case in areas without a CCA.
EPC-15-062 Robust, Low-Cost, Real-Time, NOx Sensor for Optimization of Dispatchable Distributed Generation Systems	Pre-existing intellectual property identified in agreement EPC-15-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Irvine	Group 11: Ranked # 8	N/A	N/A	Yes; Calif Based Entity	The NOx sensor is based on ceramic solid-state electrochemical sensor technology, similar to an automotive oxygen sensor. Solid state NOx sensors have been developed for direct in-situ measurement of exhaust to meet stringent on-board diagnostic requirements for self-diagnosis and reporting, including required sensitivities down to parts-per-million. The NOx sensor combines existing commercial NOx sensors with newly developed electronics for use in applications such as dispatchable distributed generation (e.g., microturbines). Unlike other NOx sensors, the sensor is a simple solid state device, with a single cell and no internal diffusion chambers (electrodes directly in the flow). This gives it faster responsiveness, and makes it both more robust and easier to manufacture.	2a, 3f, 4b	The project is completed. The results show that the two automotive solid state NOx sensors selected proved durable enough to perform reliably for the 6-month evaluation. The research team developed an engine control system integrated with information from the solid state NOx sensor and successfully demonstrated the ability to actively reduce NOx emissions at part load by 10%. The results show that solid state sensors represent an inexpensive and viable approach for monitoring emissions from distributed gas generation systems. This technology could potentially be implemented in California Air Resource Board's certification process for small distributed gas generators as an alternative to the existing Continuous Emission Monitoring System.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-064 Innovative Net Zero: ZNE Demonstration in Existing Low-Income Mixed-Use Housing	Technology Demonstration and Deployment	This project was to demonstrate the installation of innovative energy efficiency technologies in a retrofit of an existing, low-income, mixed-use multi-unit building in a dense urban setting to become zero net energy (ZNE). The recipient was unable to identify cost effective retrofits that met the requirements of the grant. As a result, the agreement was mutually terminated.	5/17/2016	No	Demand-side Management	$2,995,653	$2,995,653	$326,624	N/A	$326,624	$408,130	$0	Chinatown Community Development Center	$800,000	21.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-065 Berkeley Energy Assurance Transformation (BEAT) Project	Market Facilitation	The BEAT project focused on designing a clean energy microgrid for the public good that could be integrated into the existing fabric of a dense urban city. The project analyzed the feasibility of designing a multi-building, urban microgrid that uses solar and energy storage to share power between existing buildings to better regulate day-to-day energy supply. Additionally, in the case of a power outage, the microgrid would be able to "island" itself from the grid and provide clean back-up power for critical buildings. The BEAT team conducted a series of coordinated regulatory, technical and financial analyses to determine site feasibility, optimal configurations, operation criteria, financing strategies, and lessons learned. The financing and regulatory models provide pathways and recommendations for dense urban communities looking to develop microgrids that cross the public right-of-way. Using this analysis, other microgrid projects will be able to evaluate the benefits and challenges of urban microgrids and accelerate the non-technical planning, modeling, and financing options for microgrid and/or solar + storage projects.	5/17/2016	No	Demand-side Management	$1,499,214	$1,499,214	$1,403,559	N/A	$1,403,559	$500,070	$248,009	URS Corporation; Center for Sustainable Energy; Office of Energy and Sustainable Development, City of Berkeley; West Coast Code Consultants Inc.; NHA Advisors; Bay Area Regional Energy Network	$250,121	14.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-066 Developing an Advanced Energy Master Plan for the Encanto Neighborhood in San Diego	Market Facilitation	This project developed a prototype plan, called the Encanto Social-Economic Education Development (EnSEED) that attempts to overcome the social, financial and physical barriers to deploying emerging clean energy technology solutions in disadvantaged communities. As part of this project, the project team piloted several digital and in-person outreach strategies to the community, designed to transform an existing disadvantaged community in Southeastern San Diego into a community of near-zero net energy (ZNE) buildings. This project sought close engagement with the local community, and developed a final system design of a community-scale DER deployment as well as an accompanying financing plan. The project also developed a permitting plan that documented the necessary permit processes and required government review and approvals for deploying community-scale DER developments.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,421,437	N/A	$1,421,437	$129,898	$0	Blue Flame Energy Finance	$520,000	25.7%	Grant

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EPC-15-064 Innovative Net Zero: ZNE Demonstration in Existing Low-Income Mixed-Use Housing	Pre-existing intellectual property identified in agreement EPC-15-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Prospect Silicon Valley	Group 5: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The project site represented a test case for many of the complex challenges facing zero net energy retrofits of multi-unit, mixed-use buildings. If successful, the project approach could have been packaged for broad dissemination to the design community.	1f, 1h, 4a	On July 13, 2017, PSV informed Energy Commission staff that the project would require an unanticipated $1 million electrical upgrade in order to install the selected retrofit measures and the PV system. PSV attempted to identify alternative financing to fund the electrical service upgrade and identify new measures that could be installed using the existing electrical service. It also explored options for doing the project at a different site. However, it was unable to identify a suite of acceptable retrofit measures and a site that met the solicitation requirements and could be completed within the term of the agreement. PSV agreed to a mutual termination of the project. The termination was approved at the September 21, 2018 Business Meeting.
EPC-15-065 Berkeley Energy Assurance Transformation (BEAT) Project	Pre-existing intellectual property identified in agreement EPC-15-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Office of Energy and Sustainable Developme nt, City of Berkeley	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) set a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments are playing a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project is piloting innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in June 2018. The recipient aimed to create a shovel-ready design for an islandable, clean energy microgrid community by integrating buildings located throughout downtown Berkeley. However, challenges with crossing the public right-of-way on existing distribution lines between these non-adjacent buildings, as well as the high-cost for new distribution lines and a lack of incentives through PG&E's current tariff structure made the original design cost-prohibitive. The project team changed directions and opted to create designs for separate solar + storage systems, coupled with energy efficiency measures and smart building operation at three locations. The design allows the city to meet its resiliency goals, reduce utility energy consumption by 36-43 percent, and reduce its existing reliance on backup diesel generators during power outages, by up to 40 percent.
EPC-15-066 Developing an Advanced Energy Master Plan for the Encanto Neighborhood in San Diego	Pre-existing intellectual property identified in agreement EPC-15-066 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Groundwork San Diego-Chollas Creek	Group 4: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving the goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community scale.	2a, 3b, 3e	This project completed in 2018. As part of the project, the project team conducted a case study to document the various challenges and lessons learned in pursuing a community-scale clean energy system in a disadvantaged community. One of the challenges encountered during the project was that it took nearly eight months to receive community energy-usage data, which prevented the project team from being able to model the system design. As a result, the case study recommended that future teams submit their data requests early in the process. The case study also found that public schools could potentially serve as the location of onsite solar generation for the community since most residences may not have the ability to support rooftop PV.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-067 Integrated Community Resource Marketplace	Market Facilitation	This project developed a platform, called the Integrated Community Resource Market (ICRM), that utilizes the City of Fresno's existing policy and development plans, stakeholder input, and additional research, to compile a comprehensive list of development projects that are financially viable, align with current policy goals and timelines, and, upon implementation, produce verifiable savings of energy, greenhouse gas, and water. With a portfolio of projects identified, the project team used the platform to analyze each project to identify options for funding and financing the project, and carried out a financial analysis of each project to examine energy cost savings, incremental measure cost, return-on-investment in the form of payback with and without funding incentives, and property value improvement. This analysis was combined to develop a Master Community Design, which describes a suite of projects and specific processes for Fresno to consider adopting. Additional information is available at the project website: https://www.lgc.org/energize-fresno/	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,298,452	N/A	$1,298,452	$432,890	$0	Local Government Commission	$12,445	0.8%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-068 Understanding and Mitigating Barriers to Wind Energy Expansion in California	Applied Research and Development	The research used a combination of global re-analysis datasets, a unique set of observations, and high-resolution global climate model simulations to help identify and characterize the extent to which regions in California may exhibit vulnerability or new opportunity in terms of changes to wind resource magnitude, spatial and temporal variability, and/or operating conditions of sufficient magnitude to alter their viability for wind energy development. The unique strength of this research lies in the use of a next generation variable resolution global climate model that has the ability to simulate climate change over a limited area region, i.e., California, in a computationally cost effective manner.	5/17/2016	No	Generation	$200,000	$200,000	$200,000	N/A	$200,000	$74,830	$0	UC Davis; DNV GL	$70,000	25.9%	Grant

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EPC-15-067 Integrated Community Resource Marketplace	Pre-existing intellectual property identified in agreement EPC-15-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Local Government Commission	Group 3: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	SB 350 (2015) sets a 50 percent renewable energy standard by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and energy storage. This project piloted innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	3b, 3e	This project concluded in March 2018. The project team developed and implemented the ICRM platform on Fresno's Blackstone Avenue Corridor. The platform identified a portfolio of projects and programs that contribute to grid reliability and resiliency, increase energy efficiency and renewable energy, and deploy smart grid and zero net energy technologies. In all, 13 development sites, two activity centers, two program enhancements, and two electric vehicle charging proposals were identified as having the highest potential to provide benefits to Fresno. This portfolio is estimated to cost $30.8 million in capital expenditure and save participants $4.6 million annually net of financing costs, and generate approximately $1 million annually in positive cash flow. The final project report is available at https://www.energy.ca.gov/2018publications/CEC-500-2018-02
EPC-15-068 Understanding and Mitigating Barriers to Wind Energy Expansion in California	Pre-existing intellectual property identified in agreement EPC-15-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Lawrence Berkeley National Laboratory	Group 11: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will help overcome a key barrier to long-term wind energy investment that can help California meet its renewable energy and climate change mitigation goals. Improving the understanding of wind resource magnitude and variability over many time scales and in the context of climate change can improve the precision with which wind resources can be forecast. Technological advancement was realized through use of a next-generation variable-resolution coupled atmosphere-ocean global climate model that is capable of simulating climate and climate change at relatively high spatial resolution (7km to 14km) over California. This was the first time that a variable-resolution climate modeling system has been used for a specific energy application.	2a, 5c	The project was completed in 2018. The final report is online at https://www.energy.ca.gov/2018publications/CEC-500-2018-035/CEC-500-2018-035.pdf. The study discovered that observable large-scale patterns such as El Nino can help improve near-term predictions of wind generation. Based on future wind projections from one climate model, the team predicts that with climate change, wind power would increase during summer in most of the state and decrease during fall and winter. This study improves the characterization of uncertainty around the magnitude and variability in space and time of California's wind resources in the near future, which can reduce risk to investors and lead to greater investment in wind energy. The team communicated through three journal articles in 2018, wind investors on TAC, and an industry consultant as a project partner.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-069 Lancaster Advanced Energy Community (AEC) Project	Market Facilitation	In collaboration with the City of Lancaster and Lancaster Choice Energy (LCE), this project planned a ZNE microgrid connected to an affordable housing project that enables the cost-effective deployment of advanced technologies. The microgrid design minimizes the impact of increasing renewables on the grid, increases DER design flexibility, enables local control of energy management, and exploits the plummeting cost of islanding capability to provide valuable resiliency benefits to the community. The project team also developed a community DER valuation framework that assesses the value of DERs on an aggregated and integrated network basis from multiple stakeholder perspectives by combining various value streams and evaluating evolving revenue and market participation opportunities. This framework was used to inform the shared services model behind a "Green District" program that integrates storage, solar, and smart building technology as a service for large commercial and industrial customers to reduce their demand charges while allowing LCE to save on procurement costs. More information can be found at the project website: http://www.znealliance.org/projects/lancaster/	5/17/2016	No	Demand-side Management	$1,469,779	$1,469,779	$1,350,689	N/A	$1,350,689	$507,982	$0	City of Lancaster	$1,500,000	50.5%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-070 Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System	Applied Research and Development	This project developed a methodology for creating probabilistic fine-scale temperature zones in California focusing, initially, on summer conditions in the Los Angeles region and the greater San Francisco Bay Area. This was done for both current and future climates and land-use conditions. The project also reduced forecasting errors and uncertainties by improving the performance of the urban Weather Research and Forecasting model (uWRF). Observational weather data from a dense network of mesonet stations were used in model performance evaluation and validation.	5/17/2016	No	Grid Operations/ Market Design	$193,326	$193,326	$193,075	N/A	$193,075	$14,035	$0	Altostratus, Inc.	$5,000	2.5%	Grant

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EPC-15-069 Lancaster Advanced Energy Community (AEC) Project	Pre-existing intellectual property identified in agreement EPC-15-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Zero Net Energy (ZNE) Alliance	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Local governments can play a role in achieving California demand reduction goals by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community scale.	2a, 3b, 3e	This project concluded in March 2018. The project has resulted in a shovel-ready advanced energy community design in preparation for Phase II that includes a microgrid connecting a zero-net-energy community of 75 single-family homes for low-income residents. The project team also developed a number of resources for local governments to overcome barriers to building ZNE communities and widespread deployment of distributed energy resources. For example, they developed a financial model and policy framework for municipalities to consider land-secured financing as an option for building new residential ZNE communities. They also developed a DER valuation framework to help municipalities identify and analyze the potential value streams from community-scale deployments of solar PV, electric vehicles, battery storage, and demand response programs.
EPC-15-070 Intra-urban Enhancements to Probabilistic Climate Forecasting for the Electric System	Pre-existing intellectual property identified in agreement EPC-15-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Altostratus, Inc.	Group 11: Ranked # 6	N/A	N/A	Yes; Small Business, Calif Based Entity	This project added fine-resolution, intra-urban climate detail to coarse-scale, regional-level probabilistic or deterministic forecasting, thus allowing for more accurate, area-specific characterizations and forecasts for the electricity system and better apportionment of electricity generation.	1e	The project has been completed. The results show mean urban temperature forecasting error was reduced by up to 1.8 degrees C in the San Francisco Bay Area and up to 0.8 degrees C in the Los Angeles region. The magnitudes of intra-urban temperature variations, including effects of heat islands, are similar to or larger than those of the predicted localized impacts of climate change. Intra-urban variability in temperature (within each Energy Commission building climate zone) was found to be larger than the inter-zone differences, sometimes by several times. Therefore, intra-urban variability is important to account for in planning for electric demand and in building energy modeling.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-071 Zero Net Energy Farms	Market Facilitation	This project developed and piloted a Project Management Application tool for farm and agricultural communities. Included in this tool is information gathered from a trade study of available equipment vendors that will compare cost effectiveness and reliability of technologies for solar, wind, anaerobic digestion, and gasification. A unique feature about this project is that it integrated Net Energy Metering Aggregation (NEMA), a program through the California Public Utilities Commission (CPUC) that enables agricultural communities to aggregate meters in a continuous property, with various other strategies to maximize the effectiveness of the Project Management Application. Development and testing was done in collaboration with four local jurisdictions in the Central Valley, the San Joaquin Valley Air Pollution Control District, and the US Navy.	5/17/2016	No	Demand-side Management	$1,175,919	$1,175,919	$887,327	N/A	$887,327	$122,540	$0	West Hills Community College District; San Joaquin Valley Air Pollution Control District; Biodico, Inc.; Office of Community and Economic Development - CSU Fresno; City of San Joaquin; Fresno Council of Governments; PondelWilkinson; Red Rock Ranch, Inc.; San Joaquin Valley Clean Energy Organization ; 18Thirty Entertainment, LLC; City of Huron; Larry Alberg; Dr. Stephen Kaffka; Chelsea Teall, PE; Leon Woods III	$1,140,419	49.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-072 New Chemical Compounds for Cost-Effective Carbon Capture	Applied Research and Development	This project uses computational chemistry to support the discovery and characterization of new chemical compounds that can safely and economically capture carbon dioxide (CO2) from the stacks of power plants and other large emitters.	5/17/2016	No	Generation	$200,000	$200,000	$178,500	N/A	$178,500	$40,000	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-073 Identifying Effective Demand Response Program Designs to Increase Residential Customer Participation	Applied Research and Development	This project tested the effectiveness of innovative designs for demand response programs for residential customers using a behind-the-meter customer engagement platform developed by OhmConnect. This innovative demand response strategy integrates a recent approach that energy researchers have shown to be effective in reducing customer consumption. This strategy includes providing households with a) tailored energy-analytic feedback, b) aggregated versus single-period incentive information, c) non-financial environmental health benefit frames and d) social comparisons. An additional strategy included exploring the effects of timing of the delivered demand response information on the magnitude of household participation and response.	5/17/2016	No	Demand-side Management	$2,007,875	$2,007,875	$1,625,539	N/A	$1,625,539	$203,115	$0	University of California Los Angeles; Chai Energy	$562,633	21.9%	Grant

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EPC-15-071 Zero Net Energy Farms	Pre-existing intellectual property identified in agreement EPC-15-071 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Biodico, Inc.	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	SB 350 (2015) sets a 50 percent renewable energy standard and a doubling of energy efficiency savings by 2030. Local governments can play a critical role in achieving that goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, and demand response. This project piloted innovative planning, permitting and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in March 2018. The project developed an interactive tool designed for farm owners called the Zero Net Energy Farm (ZNEF) GeoPlanner, which enables users to assess the renewable energy potential of their property in meeting their specific energy needs. The ZNEF GeoPlanner enables users to estimate the cost and energy generation of various advanced energy technologies (such as solar, wind or biomass technology) geared specifically towards farms in California. An introduction to the ZNEF GeoPlanner is available at: http://www.zeronetenergyfarms.com/, http://www.zeronetenergyfarms.com/. Biodico used the ZNEF GeoPlanner to develop a Master Community Design at the Red Rocks Ranch in Five Points, California.
EPC-15-072 New Chemical Compounds for Cost-Effective Carbon Capture	Pre-existing intellectual property identified in agreement EPC-15-072 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Davis Campus	Group 11: Ranked # 9	N/A	N/A	Yes; Calif Based Entity	This project uses innovative ab initio quantum mechanical and molecular dynamics simulations to design and characterize carbon capturing compounds, mimicking processes previously discovered in plants in arid areas. The organic phosphoenolpyruvate (PEP) compounds in these plants store and release CO2 in a similar manner as the currently used inorganic amines. Organic molecules can be modified in a way that adjusts their reaction enthalpy, solubility, viscosity, and reaction rate to be an inexpensive, non-toxic substitute for amines in carbon capture.	2a, 4a	The research team completed simulation and optimization of candidate carbon capturing molecules using molecular dynamics modeling tool, such as Aspen Plus. The data obtained from the calculations include information about solubility and viscosity of candidate molecules, as well as their ability to form bonds with CO2 molecules. In late 2019 and 2020 UC Davis in collaboration with EPRI will model a carbon capture process in a typical electricity producing power plant for chosen candidate molecules. This exercise will provide information about the thermal energy needed by the cycle for stripping, electric energy needed by the cycle for pumping, and effectiveness of CO2 capturing processes. This modeling work will help elucidate the performance of novel carbon capturing molecules compared with commonly used amines.
EPC-15-073 Identifying Effective Demand Response Program Designs to Increase Residential Customer Participation	Pre-existing intellectual property identified in agreement EPC-15-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Regents of the University of California, Los Angeles	Group 2: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	This project tested the effectiveness of innovative design strategies for residential demand response providers and analyzed different segments of the residential population including various socioeconomic groups and residential customers with photovoltaics and electric vehicles to see what incentives, messages and energy use information motivated reliable participation in utility demand response programs. This information expanded knowledge in this area so that utility companies and regulators can build new and modify existing demand response programs to increase effectiveness. Accurate and reliable forecasts of participation in these programs will enable better utilization of existing generation resources and deferral of system capacity upgrades thereby lowering consumer electricity costs.	1c, 1d, 1e, 1h	The project is complete. The project evaluated the effectiveness of two innovative designs for residential demand response. One provided feedback information on energy use and advanced dynamic thermostat automation, the other engaged customer using social media to reduce loads when asked. Both evaluations confirmed that customers will manage their energy consumption by conserving or shifting loads if they are convinced there is a need and if their ability to participate is simplified. While the information/thermostat experiment has now ended; the participants in the social media-based program continue participating through the third-party aggregator, who continues to expand their client base and provide DR services through ISO markets.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-074 Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems	Applied Research and Development	This project develops co-optimization strategies for distributed energy resources (DERs). The purpose is to maximize customer and system value under existing CPUC-approved retail and California Independent System Operator (California ISO) wholesale tariff structures, future market structures and pricing, and the transactive energy pricing signals developed under agreement EPC-15-054. The project tests and configures two DER portfolios: a) one consisting of large retail customers and schools using battery energy storage, solar photovoltaics, and integrated load management, and b) the other consisting of hotels using passive thermal energy storage, and energy efficiency. Both will be included as part of an integrated load management strategy capable of responding to price and reliability signals. The project team is also developing operational strategies for wholesale integration subject to the identified retail and wholesale tariffs and other operational constraints.	5/17/2016	No	Grid Operations/ Market Design	$3,960,805	$3,960,805	$2,571,688	N/A	$2,571,688	$746,794	$0	Solar City Corporation; DNV GL; Conectric Networks, LLC	$1,981,262	33.3%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-075 Customer-centric Demand Management using Load Aggregation and Data Analytics	Applied Research and Development	This project will demonstrate how a large number of small loads, each impacted by and tuned to individual customer preferences can provide load management for both utilities and the ISO in California. Recipient will work with an extensive spectrum of leading product providers covering all major distributed energy resources, such as Nest (thermostats), ThinkEco (plug loads), Honda, BMW (auto), EGuana (smart Inverter) and Ice Energy (Thermal Storage). A variety of price signals will be tested, including the transactive signal developed by EPRI, Time-of-use, Critical Peak Pricing and Demand response rates.	5/17/2016	No	Demand-side Management	$3,998,587	$3,998,587	$2,150,085	N/A	$2,150,085	$1,163,894	$0	Electric Power Research Institute, Inc.; InTech Energy, Inc.; Pedagogy World, Inc.	$1,270,312	24.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-076 Richmond Advanced Energy Community Project	Market Facilitation	This project provided technical assistance to the City of Richmond in the design and adoption of a comprehensive integrated policy and planning program, and a financing framework to facilitate adoption of advanced energy technologies needed to transform the City of Richmond into a ZNE Community. As part of this project, the project team identified unique challenges to disadvantaged communities and worked with local stakeholders, including the City of Richmond, to identify and implement specific strategies to overcome those challenges. These strategies will be piloted at the conclusion of this agreement as part of a redevelopment effort to convert 20 abandoned homes into affordable ZNE homes available for working families via the First-time Home Buyers' Program.	5/17/2016	No	Demand-side Management	$1,480,111	$1,480,111	$1,246,861	N/A	$1,246,861	$370,990	$0	Energy Solutions; City of Richmond; Olivine, Inc.; Richmond Community Foundation	$2,590,134	63.6%	Grant

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EPC-15-074 Meeting Customer and Supply-side Market Needs with Electrical and Thermal Storage, Solar, Energy Efficiency and Integrated Load Management Systems	Pre-existing intellectual property identified in agreement EPC-15-074 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Center for Sustainable Energy	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The project is developing and testing strategies that customers, demand response (DR) aggregators, scheduling coordinators, and policy makers can implement to provide demand response that both meets grid needs and is acceptable to customers. The project will provide comprehensive recommendations on how to overcome technical, institutional and regulatory barriers to facilitating DER participation in supply-side markets.	1c, 1d, 1e, 1f, 1g, 1h, 3e, 3f	The project is on schedule. The prime participated in a meeting and walk-through with Hilton Hotel management, the engineering and the market participation coordination subcontractors to confirm ongoing participation. The ISO market participation analysis shows the potential for $15,000 in annual wholesale market participation as a Proxy Demand Resource. Ongoing bill savings of about $47,000 is resulting from operations optimization using the sensor/control network. Coordination with the ISO to obtain all required permission for telemetry testing for Ancillary Services market participation is ongoing. The PV/battery/load control project with 8 schools in Chino Hills continues operating; M&V data being collected.
EPC-15-075 Customer-centric Demand Management using Load Aggregation and Data Analytics	Pre-existing intellectual property identified in agreement EPC-15-075 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project is using low cost off-the-shelf technologies to develop a platform that can manage customer end-use devices according to their preferences, minimize their energy costs, and adapt to evolving tariff structures. By making the task of automating multiple end-use devices easier, less costly, and less of an imposition on customers, the project has the potential to increase demand response participation, with consequent benefits to the electric grid.	1c, 1d, 1e, 1f, 1g, 1h, 5c	The project is on track to complete in March 2020. The recipient is working with their key development partners to leverage the demand response scheduling interface with the CAISO market. Work is ongoing with project partners to fine tune the platform for data consumption and orchestration of the model commissioning is ongoing in homes located in Clovis and San Diego. In addition, the recipient continues to make progress on development of the energy information database and customer user interface requirements and testing and refining the messaging across all platforms. Next steps involve technology transfer activities including the development of a "lessons learned" white paper on the comparison of low-cost behind-the-meter monitoring with AMI data.
EPC-15-076 Richmond Advanced Energy Community Project	Pre-existing intellectual property identified in agreement EPC-15-076 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	Zero Net Energy (ZNE) Alliance	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving the goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project will pilot innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project completed in 2018. The project team developed and updated several tools to help the City of Richmond roll out strategies to deploy new clean energy technologies. This included developing a rating system to streamline the City's process for evaluating projects to finance. In addition, this included enhancing the capabilities in the Green Revolving Investment Tracking System to streamline the City's administration of Green Revolving Fund and the Social Impact Bond that will be used to finance the advanced energy projects being proposed.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-077 Huntington Beach Advanced Energy Community Blueprint	Market Facilitation	This project designed an integrated energy system to transform the disadvantaged Huntington Beach community of Oak View, into an advanced energy community (AEC). The team worked closely with ComUNIDAD, a community organization, to ensure the community needs were factored into modeling scenarios. The project team developed new design tools to simulate an integrated energy infrastructure on a community-scale, expanding the capability from the existing single-building design tools. The team evaluated multiple scenarios to determine the most optimal set of clean energy technologies and business and financial models to align the community's energy needs within the constraints of the existing electricity infrastructure.	5/17/2016	No	Demand-side Management	$1,500,000	$1,500,000	$1,402,875	N/A	$1,402,875	$508,226	$0	Southern California Gas Company (SoCalGas); Southern California Edison; County of Orange/City of Huntington Beach; The Regents of the University of California, Irvine ; National Renewable Energy Laboratory (NREL); Altura Associates, Inc.	$810,998	35.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-078 Risk Modeling and Cognitive Science Characterization of Barriers to Climate Change Adaptation in California Electricity Sector	Applied Research and Development	Researchers developed a framework for assessing climate change risk and adaptation practices in the electricity sector, identifying perceived barriers to execution of resilience strategies, and delineating practices that are currently being implemented in the electricity sector. These activities form a basis for developing a dynamic model for long-term resilience planning that can identify optimal strategies to manage climate risks. The analysis also considers how independently initiated adaptation efforts perform relative to a system-wide strategy, with a focus on electricity sector vulnerabilities.	5/17/2016	No	Grid Operations/ Market Design	$350,000	$350,000	$177,177	N/A	$177,177	$48,887	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-079 Advanced Renewable Energy Storage and Recycled Water Project	Technology Demonstration and Deployment	The Victor Valley Wastewater Reclamation Authority (VVWRA), in partnership with Primus Power, University of California Riverside (UCR), and Anaergia, is demonstrating an advanced, pre-commercial flow battery storage and control system at VVWRA's existing Regional Wastewater Treatment Plant, located in a disadvantaged community outside of Victorville. The project deploys Primus Power's ENERGYPOD flow battery system in a 240 kW/1,200 kWh configuration, managed by a UCR-designed controller system that is optimized specifically for management, generation and storage of renewable energy power. The project hopes to alleviate rapid fluctuations in the wastewater treatment plant's power demand that causes disruption of the disinfection system used to treat recycled water to California standards, resulting in the disposal of approximately 2.5 million gallons of water annually.	5/17/2016	No	Demand-side Management	$1,734,059	$1,734,059	$1,235,654	N/A	$1,235,654	$220,423	$0	Primus Power Corporation; Victor Valley Wastewater Reclamation Authority (VVWRA)	$902,215	34.2%	Grant

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EPC-15-077 Huntington Beach Advanced Energy Community Blueprint	Pre-existing intellectual property identified in agreement EPC-15-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	The Regents of the University of California, Irvine	Group 4: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments can play a critical role in achieving this goal by helping facilitate community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project piloted innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	The project ended in July 2018. Using the UrbanOpt and DEROpt tools to determine the most optimal technical and economical suite of clean energy technologies, the team developed a master community design for the Oak View AEC. Because of the mild climate and limitations with aging building stock, the plan consists of the most impactful energy efficiency upgrades (lighting and plug-loads), as well as community-scale solar PV systems mounted on carports and rooftops, and energy storage. These systems were sized to reduce the overall electrical use by the maximum of nearly 94 percent. Finally, to encourage community acceptance, the team offered a ten-week STEM course to the elementary school's after-school program, and held a series of workshops to introduce residents to green energy concepts providing materials in Spanish and playing games familiar to the predominantly Hispanic community.
EPC-15-078 Risk Modeling and Cognitive Science Characterization of Barriers to Climate Change Adaptation in California Electricity Sector	Pre-existing intellectual property identified in agreement EPC-15-078 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Berkeley	Group 8: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Researchers developed methods to account for risks, plan for resulting adaptation, and account for the barriers to adaptation. The results of research are intended to improve on the framing of climate-related policies under uncertainty and to examine all aspects of the adaptation planning process: key decision-makers, the stages of decision processes, and the institutional contexts where the decision-makers develop the decision processes. The results can inform technology choice investment and deployment to the extent that those choices are made with consideration of climate risks.	1e, 2a, 3e, 3h	This project concluded in March 2019 and an initial project report was completed. A final report has not yet been provided despite multiple attempts to contact UC Berkeley's project manager. CEC is exploring options to resolve this issue.
EPC-15-079 Advanced Renewable Energy Storage and Recycled Water Project	Pre-existing intellectual property identified in agreement EPC-15-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Victor Valley Wastewater Reclamation Authority (VVWRA)	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The project demonstrates an advanced battery storage and control system coupled with on-site renewable energy generation and its ability to control rapid changes in on site power demands. If successful, this project could reduce grid power demand and reduce energy costs to wastewater treatment plants and alleviate disruptions in recycled water production due to high variability of on-site power loads which can cause partial treatment shutdowns. The project results could be applicable to other wastewater treatment and industrial plants in California.	1h, 3c, 4c	Two new Primus battery pods were delivered and installed 10/17-10/18. Recipient is currently preparing to do to the final testing on the batteries. After the batteries are fully tested, recipient could begin testing the system based on the capacity of two batteries. Term of the project ends 3/31/2020. New updated schedule received 11/5/2019.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-080 Interdependencies of Electric Grid and Critical Lifelines: Identifying Climate Exposure and Adaptation Strategies	Applied Research and Development	This pilot study for electricity sector climate adaptation involves vigorous stakeholder engagement and systems analysis to identify and systematically account for cascading impacts internal to and outside of the electricity sector as well as resilience options. These cascading impacts include climate impacts to supply chains for electricity generation and distribution, disruption to telecommunications that the electricity sector relies on in emergencies, and other impacts that may be initially felt far away but have consequences for California's electricity system. One example of supply chain interruption is that manufacturing facilities in East Asia that produce 500kV transformers, which the California distribution system relies on, are susceptible to flooding and other extreme events linked to climate change. This study pilots a systematic framework for assessing such long-distance linkages that can disrupt electricity services and cause ripple or cascading effects on critical infrastructure in the Greater Los Angeles region. Findings from this project, which includes many diverse stakeholders, could be used to inform planning in other areas of the state.	5/17/2016	No	Generation	$128,188	$128,188	$128,163	N/A	$128,163	$0	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-081 Historical Insights for Electricity Transition Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity	Applied Research and Development	Analysis of quantitative and qualitative data sheds light on past energy technology transitions, planned and unplanned. The research team's analysis of these transition histories provided examples, principles and insights that can be used in future planning. Leveraging insights from historical technology transitions, the research team designed and tested a flexible, agent-based modeling platform ("SIMSAND") that enables researchers, utilities, and CEC demand modeling and forecasting staff to draw upon a wealth of empirical data as well as projected climate data to simulate dynamic residential demands for air conditioning. This model served as a proof of concept that might later be broadened to other energy uses and demand sectors. The model also illustrated the power of providing a platform that can draw on a variety of data streams available to illuminate energy consumption and potential transition trajectories, rather than representing key parameters as simple averages.	5/17/2016	No	Grid Operations/ Market Design	$400,000	$400,000	$393,999	N/A	$393,999	$0	$0	None	$0	0.0%	Grant

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EPC-15-080 Interdependencies of Electric Grid and Critical Lifelines: Identifying Climate Exposure and Adaptation Strategies	Pre-existing intellectual property identified in agreement EPC-15-080 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Thalassa Research & Consulting, LLC	Group 11: Ranked # 3	N/A	N/A	No	The research will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by addressing challenges in the state's largest metropolitan area -- the study of societal teleconnections. Societal teleconnections are human-created linkages that connect activities, trends, and disruptions across large distances such that locations can experience negative impacts from faraway places. This study is producing new tools and techniques to assist communities to incorporate climate impacts that are non-local in origin into their traditional climate adaptation and hazard planning. This is the first time that a systematic approach to exogenous risks is being taken for an urban area.	2a, 3a, 3e, 3g, 4a	Drawing on extensive stakeholder engagement in 2016 and 2017 as well as interactive system modeling, researchers published a final, peer reviewed report as part of California's Fourth Climate Change Assessment. Cross-cutting findings include that energy and telecommunication are critically connected to each other and to other lifelines; emergency management and public health services depend on inputs from all lifelines to be effective; workforce availability is crucial to the ability to respond effectively, but it is already limited and dependent on many different upstream lifelines; and maintaining a state of good repair on all equipment is essential to smooth functioning of all lifelines. Opportunities to advance resilience of interdependent lifeline systems include open data policies, adaptation planning mandates, and engagement at regional levels to consider extreme scenarios.
EPC-15-081 Historical Insights for Electricity Transition Scenarios in California and Flexible Energy Demand Modeling for Residential Air Conditioning with Improved Behavioral Specificity	Pre-existing intellectual property identified in agreement EPC-15-081 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	Ghoulem Research	Group 11: Ranked # 4	N/A	N/A	Yes; Calif Based Entity, Woman Own	Results improve the state's ability to estimate timing of technology penetration and accrual of benefits, and costs of desirable residential sector technologies. These results are key to improving the performance of efficiency measures outlined in AB 758 and the California Energy Code. They also support goals of CPUC's Energy Efficiency Strategic Plan, and inform updated estimates of timing and benefits as appropriate. Results portraying penetration and performance of key technologies (e.g., air conditioning) are expected to be of direct use in the scenario development and demand forecasts used in the Integrated Energy Policy Report.	5c	The research team convened in-depth discussions with members from the CEC's Demand Analysis Office, Supply Analysis Office, Building Standards Office, and Research Division as they worked to refine their flexible residential air conditioning demand forecast model ("SIMSAND"). SIMSAND, a prototype model to enable exploration of impacts of a number of human factors on residential air conditioning demand, was enhanced to have the flexibility to explore scenarios related to technology policy, adoption, and projected climate change. Through an agreement with Canadian smart thermostat manufacturer EcoBee, researchers obtained a very large data set of thermostat settings from "Donate Your Data" volunteer households. Researchers submitted a final report for publication and presented their work at the 2019 Behavior, Energy, and Climate Change Conference (BECC).

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-082 Low-Temperature Microplasma-Assisted Hydrogen Production from Biogas for Electricity Generation	Applied Research and Development	The purpose of this project is to demonstrate operation of a low-temperature microplasma reactor that will lead to an efficient, electricity-based technique to convert a mixture of carbon dioxide and methane into hydrogen for use in electricity generation. If successful, this technology could be adapted to use other gas inputs in the creation of hydrogen, such as products from the gasification of biomass.	5/17/2016	No	Generation	$200,000	$200,000	$134,857	N/A	$134,857	$35,171	$0	The Regents of the University of California, Merced	$47,199	19.1%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-083 Empowering Proactive Consumers to Participate in Demand Response Programs	Applied Research and Development	This project contains three elements to provide data for policymakers and businesses to explore this new market. First, this project determines prosumer (producer/consumer) interest in a third-party demand response market by testing user acquisition via direct and non-direct engagement strategies. Second, experimentation with behavioral and automated users allows analysis of user yield under a variety of conditions and extract a set of shadow curves that can inform how much energy load shifting can be expected under various price incentives. Finally, this project creates a novel solution for using residential telemetry to connect prosumers and their Internet of Things (IoT) devices to the market operators.	5/17/2016	No	Demand-side Management	$3,995,028	$3,995,028	$3,908,849	N/A	$3,908,849	$245,265	$0	Honeywell, Inc.; Schneider Electric USA Inc.; OhmConnect, Inc.	$1,877,378	32.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-084 Total Charge Management: Advanced Charge Management for Renewable Integration	Applied Research and Development	This project explores the benefits and opportunities of Total Charge Management, where electric vehicle charging is managed across multiple charging events to maximize vehicle load flexibility. The project tests how flexible electric vehicle load can be if managed across a driver's daily or weekly charge events. This flexibility utilizes several pricing mechanisms to estimate the benefits of the Total Charge Management approach. The research develops and evaluates advanced vehicle telematics for utilities and grid operators to align vehicle battery status, driver mobility needs, and grid conditions. Collaboration between the grid and the driver can yield a charging load profile that minimizes energy costs by aligning daily and weekly charging events to best meet grid needs.	5/17/2016	No	Demand-side Management	$3,999,900	$3,999,900	$2,975,071	N/A	$2,975,071	$330,779	$0	BMW of North America, LLC; Kevala, Inc.; Bertrandt Consulting; Sulzer US, LLC	$444,931	10.0%	Grant

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EPC-15-082 Low-Temperature Microplasma-Assisted Hydrogen Production from Biogas for Electricity Generation	Pre-existing intellectual property identified in agreement EPC-15-082 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	45 out of 45 bidders	The Regents of the University of California, Merced	Group 11: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	Determination of optimal operating parameters for microplasma array reactors to achieve maximum efficiency is an important step in overcoming barriers for advancement of technology converting biogas to syngas. Successful lab-scale demonstration can serve as the proof of concept and lead to farther development of this technology, which has the potential to generate emissions-free hydrogen for use in hydrogen-fueled ZEVs.	2a, 4a	This project was completed in 2019. The project team designed and built a plasma reactor and tested its performance for a range of operating conditions. The following are the key findings: 1) The highest registered conversion rate of CH4 and CO2 to syngas (mixture of H2 and CO) was about 30% for the conditions tested in this project (30% of injected gas was converted to hydrogen), 2) The model developed specifically for this project predicts that an array of subsequently connected microplasma reactors working in tandem would improve the performance (conversion rate), 3) Compared to hydrogen production using electrolysis (splitting of water molecules into H2 and O2 by the means of electricity), the plasma reactor consumes twice as much power (125 W vs. 56 W to produce about 200 ml of H2 in a minute).
EPC-15-083 Empowering Proactive Consumers to Participate in Demand Response Programs	Pre-existing intellectual property identified in agreement EPC-15-083 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	OhmConnect, Inc.	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project provides critical evidence that residential customers are willing to manage their electric loads for the purpose of meeting grid needs when presented with meaningful, actionable information and salient incentives. The approach makes use of multiple social media platforms for communication and has developed multiple virtual customer "experience" opportunities using those platforms that enhance participation and keep customers interested and involved. The project provides conclusive evidence that with the appropriate approach, residential customers can and will adapt their energy use to a grid that depends heavily on variable renewable generation. This evidence can be used to help policymakers and regulators develop more effective direction for utility tariff and program design and program parameters for third party aggregator participation in demand response.	1c, 1d, 1e, 1f, 1g, 1h, 3e	This project has been completed. Over 450,000 utility customers have signed up with OhmConnect, and about 35,000 of those participated in the experimental treatments conducted under the EPIC grant. About 15% of the enrolled customers live in Disadvantaged Communities. The recipient tested a number of different incentive structures--including a proxy-price "transactive" signal, including those provided by the customer's utility, the CAISO, and EPRI. Over the course of the project, the experimental subgroup saved 27.8 MWH over 1.3M #OhmHours (1-hr long participant events) for which they were paid a total of $668,000. CO2e emissions reductions were estimated at about 9 Metric Tonnes.
EPC-15-084 Total Charge Management: Advanced Charge Management for Renewable Integration	Pre-existing intellectual property identified in agreement EPC-15-084 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 21 bidders	BMW of North America, LLC	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project helps the state advance the flexibility of electric vehicle charging as a flexible grid resource and vehicle charging cost savings to the driver. Optimal charging load patterns will be identified that can capture ratepayer and grid benefits using a variety of grid price signals. The project pioneers demand response and smart charging technology advancement of not only the temporal benefits of controlled charging, but also the possible benefits that can be derived from being able to influence the location of charging.	1g	The recipient implemented and tested the control software at each of the home storage sites to assess grid and customer benefits when there was excess supply and demand response (DR) events. The default operation during these use cases maximized electricity bill cost savings by recharging the battery during the lowest cost hours, and discharging the battery when there is household electricity consumption. Project team also tested frequency regulation scenarios to assess the benefits of charging during off-peak periods and discharging during on-peak periods, and completed the renewable integration and overgeneration analysis and use case report. Two technical advisory meetings were held and a stakeholder engagement workshop held to publicize and receive feedback on the research results.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-085 San Diego Libraries Zero Net Energy and Integrated Demand Side Management Demonstration Project	Technology Demonstration and Deployment	This project is a partnership with the city of San Diego to bring ZNE to three libraries. It integrates pre-commercial energy efficiency measures, building automation, control systems, and behind the meter solar photovoltaic to retrofit three existing public libraries in San Diego.	6/14/2016	No	Demand-side Management	$2,715,516	$2,715,516	$1,070,557	N/A	$1,070,557	$725,052	$0	San Diego Gas & Electric Company; City of San Diego; San Diego Green Building Council; US Green Building Council - Los Angeles Chapter; ABM Electrical and Lighting Solutions Inc.	$543,568	16.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-086 Substation Automation and Optimization of Distribution Circuit Operations	Applied Research and Development	This project developed a Generic Microgrid Controller (GMC) to allow electrical substation control over grid assets, including generation resources, energy storage, and controllable loads. The GMC improved grid management at the distribution level. The team assessed different tariffs and interconnection agreements for a portfolio of scenarios to address the participation of DERs in the market. In addition, a fictitious retail/distribution market was developed and assessed.	6/14/2016	No	Distribution	$932,718	$932,718	$915,543	N/A	$915,543	$124,021	$0	The Regents of the University of California, Irvine ; OPAL-RT Corporation	$112,281	10.7%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-087 Cooling Tower Water Treatment using Vortex Process Technology for Energy and Water Savings	Technology Demonstration and Deployment	This agreement is funding the full-scale deployment demonstration of the Vortex Process Technology in cooling towers of commercial buildings. This technology has been used successfully in Europe and will be testing in California to address state specific goals for water and energy savings.	6/14/2016	No	Demand-side Management	$1,999,995	$1,999,995	$1,085,309	N/A	$1,085,309	$485,121	$0	Electric Power Research Institute, Inc.; Cypress LTD	$449,990	18.4%	Grant

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EPC-15-085 San Diego Libraries Zero Net Energy and Integrated Demand Side Management Demonstration Project	Pre-existing intellectual property identified in agreement EPC-15-085 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Center for Sustainable Energy	Group 5: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Combining energy efficiency and building automation with solar photovoltaics can result in an integrated approach capable of meeting the state's energy efficiency goals and providing demand response to provide grid flexibility. As the commercial sector, and local governments in particular, are risk averse, being able to demonstrate an integrated approach as well as document performance, benefits, and costs without disrupting municipal operations is key to encouraging greater adoption of the technologies. The successful implementation of technology will help other local governments and the commercial building industry budget, plan and prioritize these types of projects for existing building ZNE upgrades leading up to the state's 2030 requirements.	1e, 1f, 1h	The execution of the subcontractors amendments took longer than anticipated and the lighting installation work will need to be accelerated in order to complete on time (3/31/2020). The recipient has finalized the construction contracts to install the remaining measures in January/February 2020.The team is also finalizing the marketing/promotion for each site to inform library visitors about construction and ZNE measures and benefits.
EPC-15-086 Substation Automation and Optimization of Distribution Circuit Operations	Pre-existing intellectual property identified in agreement EPC-15-086 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Advanced Power and Energy Program (APEP) - University of California, Irvine	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project led to technological advancement and breakthroughs by developing a control strategy to manage high penetrations of distributed energy assets (including generating resources, energy storage and controllable loads) as a single unit at a substation. The GMC managed dispatchable loads and generation, reducing stress on the grid by shedding unnecessary loads and dispatching generation as required. The GMC also includes an economic dispatch feature that determined the least expensive solution to serve all the loads.	1g, 3a, 3f, 5f	This project was completed in March 2019. The final report is in process for publication. UCI completed the development and simulation, in partnership with SCE, of the GMC for enhanced substation control. The GMC showed optimal control of DERs on the distribution feeder while using the IEEE 2030.7 microgrid controller standard. UCI will create a hardware-in-loop test for the configuration using industry standard substation equipment. Although the hardware test was not funded through the grant, UCI is committed to validating the research results for purpose of grid modernization and informing stakeholders. The research results from this project informed the top power technology vendors, such as GE, Siemens, and Schneider Electric. A retail market was simulated and various tariffs were evaluated to determine benefits to developers, utilities, and grid stability.
EPC-15-087 Cooling Tower Water Treatment using Vortex Process Technology for Energy and Water Savings	Pre-existing intellectual property identified in agreement EPC-15-087 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 6	N/A	N/A	Yes; Calif Based Entity	Non-chemical water treatment has the potential to reduce water use, improve quality of water discharged to wastewater stream, reduce scaling in condenser water piping, and increase energy efficiency of chilled water plants. The Vortex technology removes calcium carbonate from recycled cooling water and improves viscosity. By removing calcium carbonate physically it reduces the amount of chemicals used in calcium removal methods.	1f, 1h, 4c, 4d, 4e	On 12/10/2019 the amendment was fully executed to extend the term by 3 months to 3/31/2019 and move funds between budget categories. Vortex system Team Data Analysis review received 11/12/2019. The following activities occurred in 2019: A) submitted an abstract to ACEEE summer 2020 study on this project as part of the Technology Transfer Activities. B) provided the a draft of the Technology Transfer Plan. C) drafted the Final Report and will be submitting for preliminary CEC review. D). prepared and provided the letters to transmit the equipment to the test sites: Amigen in Thousand Oaks and Marriott hotels (Westin in Rancho Mirage).

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-088 Biofiltration as an Advanced Primary Treatment Method to Achieve Substantial Energy Savings	Technology Demonstration and Deployment	The project is demonstrating that Biofiltration is a technically viable and commercially attractive approach to achieve significant electrical energy savings at wastewater treatment plants. This project is quantifying the electrical energy reduction and water savings that can be achieved by Biofiltration based on demonstration results at the Linda County Water District plant. This project will provide the cost and performance data to evaluate the benefits from a sustained, full scale validation testing, including quantification of electrical energy savings, determination of water savings, organic solids removal efficiencies, operation and maintenance and design criteria, independent monitoring and verification and technology transfer.	6/14/2016	No	Demand-side Management	$1,306,185	$1,306,185	$740,216	N/A	$740,216	$442,698	$0	Kennedy/Jenks Consultants; Linda County Water District; WesTech, Inc.; Professor George Tchobanoglous, Ph.D., P.E.	$271,750	17.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-089 Expanding Standards and Developing Tools to Enable DNP3 Support of Energy Storage Use Cases	Applied Research and Development	The recipient developed tools to make adoption of DNP3 for communication and control of energy storage systems simple and seamless. The project evaluated the current state of communications to DERs, worked with the DNP3 Users Group to update the existing energy storage and solar specifications to support the most advanced energy storage use cases, created an open-source DNP3 client to simplify product development of smart inverters, and developed the appropriate conformance testing tools to ensure interoperability.	6/14/2016	No	Distribution	$873,516	$873,516	$871,676	N/A	$871,676	$187,517	$0	Electric Power Research Institute, Inc.; Xanthus Consulting International; SunSpec Alliance; MESA Standards Alliance	$360,828	29.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-090 Integrated Distributed Energy Resources Management System (iDERMS)	Applied Research and Development	This project developed an Integrated Distributed Energy Resource Management System (iDERMS) to coordinate the operation of a large number of DERs. In normal grid operations, the system would aggregate multiple DERs consisting of flexible loads, renewable resources, and energy storage systems. The DERs would be coordinated to optimize power flow and respond to a distribution system operator electricity market. In an emergency situation, the system would provide any needed reactive power support to the distribution grid with smart inverters. Additionally, the system would coordinate DERs on the distribution system to help restore the grid in the event of an outage.	6/14/2016	No	Distribution	$1,119,437	$1,119,437	$874,400	N/A	$874,400	$97,356	$0	University of California, Riverside; PetaPower, Inc.	$530,392	32.1%	Grant

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EPC-15-088 Biofiltration as an Advanced Primary Treatment Method to Achieve Substantial Energy Savings	Pre-existing intellectual property identified in agreement EPC-15-088 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Kennedy/Jenks Consultants	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Biofiltration as an advanced primary treatment method could reduce the aeration electrical energy needed for secondary treatment, increase energy production in the anaerobic digester from the removed organic material and increase existing secondary treatment capacity and forestall the need for future treatment plants. Based on pilot studies outside of California, Biofiltration has the potential to decrease aeration power by 45 to 60 percent, increase gas production from 25 to 40 percent and increase treatment capacity by 50 percent.	1f, 1h, 4c	The biofilter has been running since November 2018. Preliminary results are showing an average of 87% TSS removal from the primary influent and is exceeding expectations. Energy saving analysis has not been completed.
EPC-15-089 Expanding Standards and Developing Tools to Enable DNP3 Support of Energy Storage Use Cases	Pre-existing intellectual property identified in agreement EPC-15-089 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project advanced the DNP3 protocol (communication standards for smart inverters) by making it simple and seamless while also improving communications with stand-alone energy storage systems and control of other inverter-based devices. This allows California to utilize more energy storage systems; thus, increasing the use of renewables and other DERs to support a more flexible grid.	1a, 1h, 1i, 2a, 3a, 5a	This project was completed in 2019 and the final report is in the process of being published. The team solicited inputs from a 150+ person international advisory group representing utilities, manufacturers, and researchers to identify gaps in the protocol for energy storage. The team concluded the project by performing conformance testing with other standards and streamlined the adoption through tech transfer, open source tools, and compliance testing. The standards for DER are relatively new, and this project created a framework for DNP3, which will allow organizations to be able to refine the technical and business aspects of testing. The DNP3 application note is used by both utilities and DER owners/manufacturers. IEEE 1547-2018 lists this DNP3 application note as one of three allowed protocols for managing DER.
EPC-15-090 Integrated Distributed Energy Resources Management System (iDERMS)	Pre-existing intellectual property identified in agreement EPC-15-090 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	23 out of 29 bidders	The Regents of the University of California (UC Riverside)	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project will develop controls to create virtual generators by aggregating DERs. The aggregated virtual generators would be capable of providing energy shifting, frequency regulation, and flexible ramping services to mitigate the uncertainties brought by renewable generation. The iDERMS has the potential to increase renewable penetration, reduce GHG emissions and make virtual generators cost competitive with centralized power plants.	1g, 3a, 3f, 5a	The project team completed the iDERMS platform and all the associated software modules. The Recipient met with several technology vendors, utilities, and research institutions to disseminate the knowledge gained with possibility for technology vendors to adopt iDERMS in advanced distribution management system platforms. Interested parties include SCE, SMUD, LLNL, PNNL, CAISO, GE, Siemens, and Opus One Solutions. The draft final report was submitted in October. CAM review of the final report draft was completed in late October. The Recipient is currently working on the edits for report and adding content.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-091 Energy Efficiency and Water Savings in Agriculture by Innovative Plant-Aware Irrigation System	Technology Demonstration and Deployment	This project addresses the specific problem of fixed watering schedules for agricultural crops by demonstrating a new irrigation system that saves both water and energy. This system performs on the principle that crops are watered only when needed, not just on a set time-interval. The additional benefits of this system are the improved quality and yield of the crop. The goals of this project are to demonstrate the Plant Aware Irrigation (PAI) system on perennial crops, quantify the energy and water savings, and engage customers' feedback of perceived benefits while acknowledging their concerns. The technology is being demonstrated in three vineyards.	6/14/2016	No	Demand-side Management	$1,097,990	$1,097,990	$854,033	N/A	$854,033	$220,794	$0	Fruition Sciences	$331,000	23.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-092 Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal	Technology Demonstration and Deployment	The project is demonstrating a biofiltration system that uses 15-20 percent less energy when compared to conventional technology used to treat contaminated water to meet drinking water standards or for use in industrial and/or agricultural applications. The technology is being demonstrated in the City of Barstow and the focus is removal of nitrate, perchlorate and turbidity from the wastewater. The project includes water testing to secure Conditional Acceptance as a Title 22 drinking water treatment technology from the State Water Resources Control Board.	6/14/2016	No	Demand-side Management	$1,722,072	$1,722,072	$1,558,308	N/A	$1,558,308	$0	$0	MWH; City of Barstow; Tomorrow Water dba BKT United; Kana Engineering Group, Inc.; Khalil Kairouz Consulting; Eurofins Eaton Analytical	$417,497	19.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-093 Accelerating Drought Resilience Through Innovative Technologies	Market Facilitation	This project compiled data from county utilities to find what industries had the highest energy impact during the drought. Then, the project provided input on what water-energy technologies would lessen the impact during future droughts. Finally, the team assisted local jurisdictions in implementing strategies and measures that reduce development times and costs, as well as recommended innovative financing mechanisms and cutting edge water-energy technologies. The recipient piloted the model for Tulare County in an effort to develop a roadmap for implementation of the model in other similar rural agricultural communities.	6/14/2016	No	Demand-side Management	$1,000,000	$1,000,000	$999,376	N/A	$999,376	$178,824	$0	Syzergy, Inc.	$5,000	0.5%	Grant

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EPC-15-091 Energy Efficiency and Water Savings in Agriculture by Innovative Plant-Aware Irrigation System	Pre-existing intellectual property identified in agreement EPC-15-091 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The technology being demonstrated precisely detects when crops need water, triggering irrigation only when needed. Delivering less water reduces pumping and the associate energy use, lowering GHG emissions. Expanded deployment to other California perennial fruit crops has the potential to save significant amounts of energy and water, moving the state closer to its energy goals.	1f, 1h, 3g, 4a, 4c	The project results estimated a 61% combined water and energy savings annually, compared to traditional irrigation. The project's final meeting was December 3, 2019. The fruit ripening conditions, quality and yield were not impacted by the optimized irrigation system. EPRI held a Pollinator Workshop and the project team presented to local farmers at Fresno State University (FSU) 2019 Innovations in Ag Irrigation Technology Showcase to highlight the emerging irrigation and water management technology. The FSU presentation will be featured in West Coast Industrial Solutions magazine. Future market transfer activities will be focused toward wine grape growers and water intense agriculture sectors. These opportunities will concentrate on the objectives and practical aspects to understand the requirements. The technology will also be applied to avocado crops under an
EPC-15-092 Low Energy Biofiltration System with Low Backwash Rate for Groundwater Contaminant Removal	Pre-existing intellectual property identified in agreement EPC-15-092 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Tomorrow Water dba BKT United	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity, Minority Owned	The project is anticipated to offer a lower energy alternative for treatment of the most common contaminants preventing use of ground water resources in California. The project could enable the development of new water supplies in many of the drought challenged regions of the State. Local treatment of impaired groundwater will provide additional energy benefits by eliminating the cost associated with transporting clean water from distant sources. The biofiltration treatment technology has the potential of efficiently treating contaminated water in an energy efficient manner while generating no waste brine.	1f, 4a, 4d	The Recipient finished the acclimation process to introduce microorganisms for colonization of the bioreactor. The biofiltration system is operating in continuous mode; it was previously running in batch mode as the Regional Water Board had concerns over the perchlorate concentration. The Recipient is currently in the Title 22 process. Recently, there were some issues with the effluent discharge area becoming over saturated so the recipient is rerouting the effluent but is evaluating a more permanent fix. Electricity data will be collected at the main submeter for the biofiltration system and compared to the baseline to calculate savings.
EPC-15-093 Accelerating Drought Resilience Through Innovative Technologies	Pre-existing intellectual property identified in agreement EPC-15-093 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Water Energy Innovations, Inc.	Group 3: Ranked # 1	N/A	N/A	Yes; Small Business, Calif Based Entity, Minority Owned, Woman Own	This project will develop a comprehensive regional drought resilience plan that will match high potential energy and water efficiency technologies with potential adopters. This will lead to greater reliability and drought resiliency while reducing agricultural energy demand.	3e, 4c	This project completed in October 2018. The project identified specific technology solutions and strategies that Tulare County and similar communities can use to build drought resilience while also supporting electric reliability and reducing greenhouse gas emissions. A model Drought Resilient Technologies Program, developed by the project, is embodied in the Drought Resilient Toolkit ("http://droughtresilience.com/"]http://droughtresilience.com/). This project found that most drought resilient opportunities involve actions and investments by water users, and that significant draught resilient in Tulare County could be achieved by implementing just the following solutions: convert flood to drip irrigation, recycle/reuse food processing water, and accelerate change outs to water efficient fixtures.

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2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-094 ** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	Technology Demonstration and Deployment	This project is demonstrating cost-competitive ZNE design strategies that combine occupant needs with technology solutions to create new pathways for residential ZNE communities. The strategies will be demonstrated in single and multifamily buildings. The project's goals are cost effectiveness for the customer, affordability, overcoming customer apprehension, establishing a track record of new technology for builders, enabling distribution grid integration, creating a planning process for ZNE communities, evaluating community solar and evaluating the impact of future changes to ZNE cost effectiveness. This project also aims to understand the operation and energy use of the unregulated loads.	6/14/2016	No	Demand-side Management	$3,207,432	$4,942,809	$1,208,495	N/A	$1,208,495	$1,460,838	$0	Electric Power Research Institute, Inc.; LINC Housing Corporation; Fresno Housing Authority	$1,109,482	18.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-094 ** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	Technology Demonstration and Deployment	This project is demonstrating cost-competitive ZNE design strategies that combine occupant needs with technology solutions to create new pathways for residential ZNE communities. The strategies will be demonstrated in single and multifamily buildings. The project's goals are cost effectiveness for the customer, affordability, overcoming customer apprehension, establishing a track record of new technology for builders, enabling distribution grid integration, creating a planning process for ZNE communities, evaluating community solar and evaluating the impact of future changes to ZNE cost effectiveness. This project also aims to understand the operation and energy use of the unregulated loads.	6/14/2016	No	Demand-side Management	$1,735,377	$0	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-096 Demonstrating Innovative Leakage Reduction Strategies: Correlating Continuous Acoustic Monitoring, Satellite Imagery and Flow Sensitive Pressure Reducing Valve System	Technology Demonstration and Deployment	This project is demonstrating three leak detection technologies to reduce the amount of water lost from leaks and the amount of embedded energy wasted due to these leaks. The technologies tested include satellite imagery leak detection, correlating continuous acoustic monitoring, and flow sensitive pressure reducing valves. These technologies have site demonstrations in four Southern California cities. The Recipient will present achievable and measurable water savings in water distribution systems and show the potential for water and energy savings. An economic analysis of the costs and benefits of the technologies will be developed to assist in considering solutions for water loss reduction and energy efficiency. The project benefits will be quantified through water saved, embedded energy saved and associated greenhouse gas emissions reduced.	6/14/2016	No	Demand-side Management	$1,517,780	$1,517,780	$1,345,378	N/A	$1,345,378	$222,664	$0	Hazen & Sawyer; American Water Works Company, Inc.; Echologics	$391,461	20.5%	Grant

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EPC-15-094 ** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	Pre-existing intellectual property identified in agreement EPC-15-094 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Electric Power Research Institute, Inc.	Group 6: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This research will provide new methodologies for integrating occupant and technology needs into a cost effective and scalable zero net energy (ZNE) strategy. The project will analyze and define the savings and market barriers in residential communities and provide new, valuable performance data and models from the demonstrations. The products from this research will be essential to identifying the successes and barriers to meeting the ZNE goals for residential communities.	1f, 1h, 2a	Home construction has been completed for three sites: single family unit in Belmont and multifamily units in Compton and Pomona. The Fresno multifamily project will be completed June 2020. Ribbon cutting for the Belmont site is scheduled for 12/10/19. The project leverages the latest energy technologies that can support decarbonization.
EPC-15-094 ** Demonstration of Affordable, Comfortable, Grid Integrated Zero Net Energy Communities	Pre-existing intellectual property identified in agreement EPC-15-094 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Electric Power Research Institute, Inc.	Group 6: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This research will provide new methodologies for integrating occupant and technology needs into a cost effective and scalable zero net energy (ZNE) strategy. The project will analyze and define the savings and market barriers in residential communities and provide new, valuable performance data and models from the demonstrations. The products from this research will be essential to identifying the successes and barriers to meeting the ZNE goals for residential communities.	1f, 1h, 2a	Home construction has been completed for three sites: single family unit in Belmont and multifamily units in Compton and Pomona. The Fresno multifamily project will be completed June 2020. Ribbon cutting for the Belmont site is scheduled for 12/10/19. The project leverages the latest energy technologies that can support decarbonization.
EPC-15-096 Demonstrating Innovative Leakage Reduction Strategies: Correlating Continuous Acoustic Monitoring, Satellite Imagery and Flow Sensitive Pressure Reducing Valve System	Pre-existing intellectual property identified in agreement EPC-15-096 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	American Water Works Company, Inc.	Group 2: Ranked # 7	N/A	N/A	No	This project will advance the technical knowledge of detecting and preventing underground water leaks and estimating the energy savings associated with the water leak detection/prevention strategies. Identifying and demonstrating tools to help water agencies monitor, assess and manage their water distribution systems conserves water resources, increases water system reliability, lower emergency and repair costs and reduces water and electricity costs for ratepayers. These benefits will be quantified through the volume of water saved and the embedded energy in the saved water.	4c	Data collection and analysis is complete. The final report is being finalized with data collected. A presentation on the project was given at the American Water Works Association CA/NV Conference in Sacramento in March 2019.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-15-097 Achieving Zero Net Energy in Multi-family Buildings	Applied Research and Development	This project demonstrates the potential of breakthrough electric water heating and space conditioning technologies as a pathway to zero net energy. The project explores the complex, interdependent systems in multifamily buildings and how they work together to achieve zero net energy status for the buildings in a cost-effective manner. Four multifamily buildings, designed to be affordable, are to be evaluated in various stages of design and development. These buildings share a goal of all electric zero net energy construction with 100 percent renewable energy generation, and utilize innovative new heat pump technologies to serve the buildings water heating and/or space conditioning needs.	6/14/2016	No	Demand-side Management	$1,955,811	$1,955,811	$1,405,820	N/A	$1,405,820	$180,555	$350,498	Corporation for Better Housing; MidPen Housing Corp.	$290,090	12.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-001 Measure Results from Affordable Zero Net Energy Homes	Applied Research and Development	The project implements lessons learned from previous high performance housing research and measures the results in two new homes being built in partnership with Habitat for Humanity in a disadvantaged community in Stockton. Both houses include advanced architectural design features, high performance enclosures, advanced heating, ventilating and air conditioning systems, and low-cost water heating systems. One all-electric home and one mixed fuel (combined electric and natural gas) home is being built to demonstrate the respective cost-effectiveness of each set of features. In addition to measuring actual performance of occupied houses, the project is developing a guide to affordable residential zero net energy design and construction along with a training curriculum, and will offer training opportunities based on the project results.	7/13/2016	No	Demand-side Management	$1,000,000	$1,000,000	$479,262	N/A	$479,262	$325,815	$0	Southern California Gas Company; Dettson	$168,500	14.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-002 Pathways to More Cost-Effective ZNE Homes	Applied Research and Development	This study provides detailed cost-effectiveness modeling of all electric, Zero Net Energy (ZNE) homes compared to mixed-fuel ZNE homes with gas-based heating. Evaluation includes costs of building integration, energy efficiency packages, installed equipment, and lifetime investment costs. The project provides spatial and temporal analyses to enable an assessment of cost-effectiveness in four California climate zones. This information will help policy makers better understand the cost and benefit tradeoffs of ZNE policy - and allow for more informed planning to reach ZNE targets in 2020 and 2030. It will also provide the information on the climate trade-offs of all electric homes compared to those with electric and gas service.	7/13/2016	No	Demand-side Management	$1,000,000	$1,000,000	$1,000,000	N/A	$1,000,000	$436,541	$0	Lawrence Berkeley National Laboratory	$50,000	4.8%	Grant

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EPC-15-097 Achieving Zero Net Energy in Multi-family Buildings	Pre-existing intellectual property identified in agreement EPC-15-097 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Build It Green	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The project demonstrates the technical and economic feasibility of zero net energy design for large multifamily projects and establishes design and installation best practices that minimize risks for developers. This includes documentation of best practices to ensure that energy and cost benefits of zero net energy are fully realized and identified, including the trade-offs between technology solutions, capital costs, operating and maintenance costs, environmental benefits and grid impacts.	1f, 1h	This project is on track. The construction of all four multifamily buildings in Sunnyvale, Atascadero, Cloverdale and Calistoga is now complete. The installation of domestic hot water monitoring devices such as meters, data loggers and sensors were completed for all buildings in 2018. Energy display installations, which uses colors to inform occupants in real time how much energy is being consumed, were installed at all sites March 2019. Data collection on DWH, thermal storage, HVAC, systems performance, electrical consumption, occupancy behavior will be completed by early 2020, then analysis to determine technical and cost effectiveness and how close each building is achieving Zero Net Energy will start. The monitoring period will be completed in May of 2020.
EPC-16-001 Measure Results from Affordable Zero Net Energy Homes	Pre-existing intellectual property identified in agreement EPC-16-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Institute of Gas Technology dba Gas Technology Institute	Group 2: Ranked # 1	N/A	N/A	No	The technological advancement in this project is to utilize innovative construction approaches that couple advanced energy efficiency measures with integrated project design and delivery (IPD) in a cost-effective manner. These approaches aim to reduce structural framing to minimize heat paths through the walls, improve wall and attic insulation, increase equipment efficiency, reduce air infiltration levels, and improve water heater and HVAC performance. The approaches will emphasize minimum energy use, high indoor air quality, robust and appealing architectural design, solid structural integrity, and practical, low cost construction. If successful, these innovative approaches could become standard construction practice leading to widespread deployment of affordable ZNE homes.	1e, 1f, 1h, 2a	Progress this year includes making significant headway on construction efforts which is anticipated to be completed by December 2019. Data measurement and verification plan was finalized for the two demonstration sites. Project team has also made substantial progress developing an eBook that details the innovative energy efficient construction practices being utilized. Project team has begun planning several builder training seminars in PG&E and SoCal Gas service territories.
EPC-16-002 Pathways to More Cost-Effective ZNE Homes	Pre-existing intellectual property identified in agreement EPC-16-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Lawrence Berkeley National Laboratory	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project identifies key cost-reduction opportunities to inform future policy decisions and includes development of cost data on photovoltaic cost reduction potential, building shell measures, and future end-use appliance costs and performance and estimates of cost sensitivities of various ZNE related issues. The latter includes offsite renewable energy procurement, climate impacts, and policy levers, such as mortgage tax credits and incentives.	1f, 1h, 4a	This project is complete. The final report was received. A few key takeaways from the project are: New all-electric homes have comparable 30-year lifecycle costs to mixed-fuel homes when cost optimized for 2019 Title 24 compliance while offering significantly lower CO2 emissions (average of 38% lower). All-electric home costs can benefit from reduced infrastructure costs for gas lines. All-electric single-family homes with cost-optimized designs have an average of 1kW larger solar PV system sizes compared to mixed-fuel homes to offset increased electricity consumption. Full ZNE home can be achieved by oversizing solar PV systems to offset the TDV of building's total annual site energy usage

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-003 Pilot-Scale Evaluation of an Integrated Building Control Retrofit Package	Applied Research and Development	This project tests an integrated building control package that maximizes energy efficiency for existing commercial buildings. The project refines novel control algorithms that utilize shared device state and environmental data for lighting, fenestration and heating, ventilating and air conditioning (HVAC) systems. Sharing data from multiple device types will further improve overall, sustained, system performance and operation. Control algorithms prioritize lighting or heating/cooling savings based on climate and building design. HVAC system management leverages passive ventilation through windows and skylights and dynamic adjustment of HVAC set point dead bands.	7/13/2016	No	Demand-side Management	$1,999,089	$1,999,089	$1,067,673	N/A	$1,067,673	$349,266	$0	Regents of the University of California, Davis - California Lighting Technology Center	$267,363	11.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-004 Integrated Whole-Building Zero Net Energy Retrofits for Small Commercial Offices	Applied Research and Development	This project develops and evaluates cost-effective packages of pre-commercial integrated energy efficiency measures and controls to achieve zero net energy (ZNE) performance for small commercial offices in California. The project team is utilizing Lawrence Berkeley National Laboratory's FLEXLAB to test whole-building integrated systems under varied climate and use conditions, with additional testing to be conducted at a retrofitted office building in Berkeley, CA. The team is aiming to achieve a minimum of 50 percent energy savings over baseline conditions at the retrofit site to achieve ZNE. Data on energy, occupant comfort, and occupant behavior are being analyzed to identify best practices that can be replicated elsewhere in the State.	7/13/2016	No	Demand-side Management	$2,000,000	$2,000,000	$1,760,556	N/A	$1,760,556	$781,092	$0	Northern California test site partner	$2,000,000	50.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-005 Energy Efficient HVAC Packages for Existing Residential Buildings	Applied Research and Development	This project demonstrates innovative pre-commercial, cost-effective retrofit packages for cooling and ventilation for single family homes. Energy savings, occupant behavior and indoor air quality (IAQ) are to be measured for two specific retrofit packages that each includes three innovative technologies: (1) building envelope sealing, (2) two variants of smart mechanical ventilation that include pre-cooling strategies, and (3) mostly compressor-free evaporative air-conditioning. Furthermore, barriers and opportunities towards adoption of such retrofits are to be identified through stakeholder interviews.	7/13/2016	No	Demand-side Management	$1,200,000	$1,200,000	$478,902	N/A	$478,902	$366,421	$126,000	None	$0	0.0%	Grant

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EPC-16-003 Pilot-Scale Evaluation of an Integrated Building Control Retrofit Package	Pre-existing intellectual property identified in agreement EPC-16-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Regents of the University of California, Davis - California Lighting Technology Center	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	This project seeks to improve sensor-controlled lighting and air conditioning systems by integrating and sharing information from multiple sensors, resulting in better quality indoor spaces with reduced energy cost. This research will focus on refinement and testing of an Integrated Building Control Retrofit Package. The includes the refinement of novel control algorithms that utilize shared device state and environmental data among lighting, fenestration and HVAC devices. This is a breakthrough because most lighting and HVAC controls operate independent of each other and this project hopes to integrate both.	1f, 1h, 3e	The recipient started installation in July 2019 at the demonstration site, the Barn, on the UC Davis campus. The recipient will install controllable window shades, smart thermostats, and lighting with controls and will determine whether the lab scale control algorithms work in real world conditions.
EPC-16-004 Integrated Whole-Building Zero Net Energy Retrofits for Small Commercial Offices	Pre-existing intellectual property identified in agreement EPC-16-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project develops and validates integrated whole building retrofit packages using pre-commercial underutilized technologies and controls with the goal of reducing energy use in small commercial offices by at least 50 percent. The project also aims to increase system reliability by reducing peak energy loads and potentially supporting automated demand response implementation. The energy efficiency and demand reduction components of the project provide a path towards meeting the State's energy efficiency and climate goals along with a means to replicate these strategies.	1e, 1f, 1h, 2a, 4a	Progress this year includes participating in the 2019 EPIC Symposium poster session, selecting a contractor to implement the retrofits, obtaining City of Berkeley approval for ZNE retrofit work to begin, and completing FLEXLAB testing of retrofit technologies to be deployed at the city test site. Project team continues to analyze data from FLEXLAB testing and integrate findings into an online commercial building energy modeling tool. Project outreach activities were also completed such as presenting at conferences including AEE West Conference in Santa Clara and New Buildings Institute's Getting to Zero Forum in Oakland.
EPC-16-005 Energy Efficient HVAC Packages for Existing Residential Buildings	Pre-existing intellectual property identified in agreement EPC-16-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Regents of the University of California, Davis	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	To address the current issues with indoor air quality and energy efficiency in existing homes, this project evaluates two residential retrofit packages that incorporate advanced technologies for achieving both of these goals. Better envelope tightness combined with a dedicated ventilation system and highly efficient evaporative cooler will increase indoor air quality, reduce energy use for air conditioning and reduce overall peak demand. Additionally, the technology could reduce energy costs for building owners/occupants.	1f, 1h, 2a	One year of baseline and six months of field monitoring were completed with the Smart Vent and Night Breeze systems along with the sub wet bulb evaporative cooling and DX coil. Two unique retrofit packages were installed in December 2018. Post monitoring started in early June 2019. Both sites received aerosol envelope sealing, and a sub wet bulb indirect evaporative cooling (IDEC) with a fresh air vent system. A small add-on direct expansion coil was added to each IDEC unit to allow for extra cooling during summer temperatures. Indoor air quality measurements monitored CO2 and PM 2.5. Initial results show that the home with the single cold water coil in the attic from the IDEC met the home's temperature requirements, but the home with the multiple mini-splits system supplied by the IDEC was unable to keep occupants cool. Recipient currently analyzing the data to make improvements.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-006 Low Energy, Zero Liquid Discharge Adsorption Technology to Remove Contaminants and Recover Source Water	Applied Research and Development	The project is testing an innovative, low energy, zero liquid discharge water treatment system using adsorption process to potentially remove arsenic and other contaminants from a groundwater reservoir. The project is developing a demonstration-scale water treatment system to determine operational costs, energy and water savings of the single use adsorption system The demonstration will validate the reduction in spent adsorption media by natural dehydration to further save energy and water associated with residual solid waste handling. The project includes testing and reporting to secure state mandated acceptance of the novel drinking water treatment technology.	7/13/2016	No	Demand-side Management	$986,262	$986,262	$650,977	N/A	$650,977	$0	$0	ES Engineering Services, LLC; Khalil Kairouz Consulting; Enova Water LLC; AQUAlity Engineering, Inc.; Municipal Management Group, Inc.	$194,904	16.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-007 Optimization of Energy Efficiency to Achieve Zero-Net Energy in Multifamily and Commercial Buildings	Applied Research and Development	This is a modeling study. The recipient uses EnergyPlus, a building energy modeling tool, to analyze the cost-effectiveness of various electricity saving/generation measures for multifamily and commercial buildings in California. Each building type and climate zone will receive a cost-benefit analysis for each measure individually and an optimized package of measures to achieve as close to zero net energy as is cost-effectively possible.	7/13/2016	No	Demand-side Management	$1,000,000	$1,000,000	$582,314	N/A	$582,314	$151,821	$0	Electric Power Research Institute, Inc.; Regents of the University of California, Davis	$105,000	9.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-008 Santa Monica Advanced Energy District	Market Facilitation	The city of Santa Monica designed an advanced energy district with a multiuser microgrid that is anchored at the City Yards, an old landfill site where most of the city's municipal buildings and fleets are housed. The design integrates a suite of local renewable energy sources, energy storage, and controllable loads into a single system that can be scaled to interconnect adjacent, public and private properties inclusive of the Bergamont Art District and Metro Maintenance Facility. The project team explored what role the city can play in delivering and wheeling power between customers, and what special utility tariffs and financing can help incentivize a system that shares the value of distributed energy resources equitably. Next, the project team developed a financial and ownership model for constructing and operating a multiuser microgrid that achieves a net-zero, or near net-zero energy district for the customers. A case study and tool kit of outreach materials was developed to share with stakeholders and other local governments.	8/10/2016	No	Demand-side Management	$1,487,609	$1,487,609	$488,097	N/A	$488,097	$570,347	$0	Arup North America Ltd; City of Santa Monica; Hathaway Dinwiddie Construction Company; Miller Hull Partnership; Buro Happold Engineering	$253,030	14.5%	Grant

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EPC-16-006 Low Energy, Zero Liquid Discharge Adsorption Technology to Remove Contaminants and Recover Source Water	Pre-existing intellectual property identified in agreement EPC-16-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	ES Engineering Services, LLC	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	This project could result in an innovative way to treat water with high amounts of metal contaminants using a low energy treatment method to restore impaired drinking water sources. The hydrogel adsorption process offers benefits of being simple, with its minimal amount of equipment required and can save water that would normally be too difficult to treat. This treatment method is especially suitable for small inland treatment systems, where liquid backwash and brine disposal may be cost prohibitive or infeasible.	1h, 4c, 4d	The recipient is continuing the measurement and verification of the system, and, due to minor equipment issues, has been cautiously proceeding with water treatment.
EPC-16-007 Optimization of Energy Efficiency to Achieve Zero-Net Energy in Multifamily and Commercial Buildings	Pre-existing intellectual property identified in agreement EPC-16-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	Regents of the University of California, Davis	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will accelerate the adoption of cost-effective electricity saving and generation technologies, equipment, materials and construction practices in California multifamily and commercial buildings. By developing new methods and expanding on existing modeling methods using OpenStudio, a building energy modeling software developed by the Department of Energy, this project aims to enable rapid evaluation of energy efficiency packages to determine the most cost-effective approaches to achieve zero net energy buildings.	1f, 1h, 3e	Specifying the parameters for each technology and developing a cost data format that is appropriate for the cost model is ongoing. The recipient recently provided a presentation on preliminary modeling results and methodology for screening measures based on marginal costs of energy from photovoltaics. By assessing each efficiency measures relative costs versus installing additional solar generation the recipient is able to prioritize measures by cost-effectiveness.
EPC-16-008 Santa Monica Advanced Energy District	Pre-existing intellectual property identified in agreement EPC-16-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	City of Santa Monica	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Senate Bill 350 (2015) sets a 50 percent renewable energy standard and a goal of doubling energy efficiency savings by 2030. Local governments must play a role in achieving the goal by operationalizing community-scale deployment of Integrated Distributed Energy Resources (IDER) such as energy efficiency, onsite renewables, demand response, and electric vehicles. This project pilots innovative planning, permitting, and financing approaches and tools to help improve the business case for IDER adoption at the community-scale.	2a, 3b, 3e	This project concluded in December 2018. After evaluating several technical and financial options, the team developed three scenarios to provide a phased approach for a low-carbon energy solution to the City of Santa Monica and surrounding community. The base-case scenario includes 1.2 MW solar PV and 7.2 MWh energy storage to meet the projected energy demand for the redeveloped City Yards, and allows for 2 days of continued operation in a power outage. The two expansion scenarios include increased solar generation and energy storage, as well as fuel cells to meet the significantly higher demands for the adjacent Bergamont Art District, and the Metro's maintenance facilities located across the street. The City will vote on a final microgrid design once the City Yards redevelopment plan is complete and financing becomes available.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-009 Testing a Low-Energy Water Treatment System for Fail-Safe Direct Potable Reuse	Applied Research and Development	The project is testing a low-energy, dual barrier, direct potable reuse system, known as dprShield, with breach-activated barrier technology to demonstrate that this technology can improve public health safeguards and reduce the electrical energy, chemical consumption, maintenance and overall cost for potable reuse of municipal wastewater. While being energy efficient and cost-effective, this system effectively removes trace contaminants through two tight membranes. In the event that one of the membrane barriers is breached, a Breach Activated Barrier is triggered and the contaminants are pushed away from the clean water stream, ensuring safe operation in real time. This direct potable reuse technology could replace more energy intensive processes.	8/10/2016	No	Demand-side Management	$999,795	$999,795	$881,325	N/A	$881,325	$248,634	$2,826,591	Orange County Water District; Leland Stanford Junior University; Porifera, Inc.; City of Hayward	$144,784	12.6%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-010 Improving Water and Energy Efficiency in California's Dairy Industry	Applied Research and Development	This project tests and demonstrates two novel approaches to cooling livestock. With conduction cooling, the bedding area beneath the cow is cooled using heat exchange mats below the stall bedding. To reduce energy consumption, water flowing through the heat exchange mats is chilled using a novel Sub-Wet Bulb Evaporative Chiller. The second approach, targeted convection cooling, uses fabric ducting to direct cool air on the cows. The air is cooled using high-efficiency direct evaporative coolers. Both approaches promise significant water and energy savings, when compared to current approaches.	8/10/2016	No	Demand-side Management	$1,000,000	$1,000,000	$519,360	N/A	$519,360	$191,936	$0	Regents of University of California, Davis	$164,710	14.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-011 Novel Membrane Technology to Improve Energy Efficiency and Water Savings in Wastewater Treatment Operations	Applied Research and Development	This project was to demonstrate and assess the potential of an innovative amphiphilic, anti-adhesive membrane technology (developed by membrane manufacturer, inge/BASF) designed to minimize foulants onto membrane surface to improve the performance of membrane filtration systems used by drinking water and water reclamation agencies.	8/10/2016	No	Demand-side Management	$882,430	$882,430	$736,251	N/A	$736,251	$304,611	$0	Kennedy/Jenks Consultants; BASF; California Water Services	$98,600	10.1%	Grant

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EPC-16-009 Testing a Low-Energy Water Treatment System for Fail-Safe Direct Potable Reuse	Pre-existing intellectual property identified in agreement EPC-16-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Porifera, Inc.	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	This project demonstrates an energy efficient solution for direct potable reuse of municipal wastewater. The dprShield is estimated to use 65 percent less energy than State Water Project transfers, 75 percent less than desalination and more than 50 percent less energy than competing technologies for direct potable reuse of municipal wastewater, removal of contaminants from water and real-time membrane integrity monitoring.	1f, 1h, 4c, 4d	The final report has been submitted. The pilot demonstration results show that the dprShield uses 33% less energy than competing DPR solutions and 70% less energy compared to desalination.
EPC-16-010 Improving Water and Energy Efficiency in California's Dairy Industry	Pre-existing intellectual property identified in agreement EPC-16-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Regents of University of California, Davis	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project advances management strategies for reducing thermal stress in dairy cows while also reducing energy and water use. There are two methods of reducing thermal stress in cows: (i) lowering the cow's heat exposure and (ii) increasing the cows ability to get rid of excess body heat. Current practice includes use of evaporative cooling with water sprayed on the cows using feed-line soakers, and cooling is enhanced by convective heat transfer via large overhead fans. This project will test and demonstrate an innovative approach that seeks to optimize the cow's ability to remove excess body heat by utilizing more efficient cooling technologies, and introducing alternate strategies for when and where to cool the cows. By combining these two approaches this project has the potential to significantly change the way dairy cows are cooled.	1e, 1f, 1h, 4a, 4c	Installation and testing of the full-scale system has begun in Pixley, CA. Data collection on the "ducted" strategy is ongoing. Data collection will be limited during the winter period, but if temperature thresholds are met the data will be collected. The recipient will work on data analysis for the current sample period and provide preliminary results and conclusions to CEC staff over the winter of 2019.
EPC-16-011 Novel Membrane Technology to Improve Energy Efficiency and Water Savings in Wastewater Treatment Operations	Pre-existing intellectual property identified in agreement EPC-16-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Kennedy/Jenks Consultants	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	A survey by the American Membrane Technologies Association (AMTA) indicates that there are approximately 100 microfiltration/ultrafiltration treatment plants with a total design capacity of approximately 400 MGD, eight nanofiltration facilities (30 MGD), and over 100 reverse osmosis (RO) facilities (400 MGD) in California. As membrane treatment is energy intensive due to fouling, this technology could reduce energy demand for membrane treatment processes while decreasing the water need for backwashing.	1f, 1h, 3a, 4a, 4c	EPC-16-011

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-012 Power and Water Saving Advanced Hybrid Air/Wet Cooling System	Applied Research and Development	This project uses high performance porous fins to enhance cooling through water vaporization and mass transfer. By retrofitting the heat exchanger with a water spray feature, this project has the potential to reduce energy and water use of HVAC and refrigeration systems in California.	8/10/2016	No	Demand-side Management	$999,994	$999,994	$840,227	N/A	$840,227	$529,685	$0	Altex Technologies Corporation	$187,207	15.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-013 Integrating Smart Ceiling Fans and Communicating Thermostats to Provide Energy-Efficient Comfort	Applied Research and Development	This project develops an optimal system configuration for smart comfort controlled ceiling fans integrated with learning thermostats. This system is to be tested and evaluated for energy performance and occupant acceptance in low income multi-family residential and small commercial buildings in disadvantaged communities in California. This research and development advances the solution's technology readiness level and support market adoption acceleration. A design guide and energy code language are to be developed to facilitate widespread adoption.	8/10/2016	No	Demand-side Management	$1,888,683	$1,888,683	$974,902	N/A	$974,902	$188,176	$0	Center for the Built Environment - UC Berkeley; BIG ASS FANS	$315,926	14.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-014 A New Solution to California's Energy and Water Challenges: Reducing the Cost of Desalination and Increasing Water Reuse	Applied Research and Development	This project is demonstrating how to reduce the energy used to remove salt from wastewater using the flow-through electrode capacitive desalination (FTE-CD) technology. This advanced technology removes salt from water by applying an electric field to two porous electrodes. The electrodes act like a magnet for salt while the field is applied and remove the salt from water that flows through the electrodes using less energy and less costly than reverse osmosis (RO). Energy use of an FTD-CD system is projected to be 50% less compared to the energy use for an RO system. The recipient is partnering with two water districts to test the use of FTE-CD devices to desalinate wastewater and determine how this small, flexible device can improve the energy and operating efficiency of wastewater treatment solutions for communities. Wastewater from the industrial and municipal sectors will be used to test the technology along with measuring energy use and performance, such as fouling and other operation issues.	8/10/2016	No	Demand-side Management	$999,040	$999,040	$875,000	N/A	$875,000	$448,176	$0	None	$0	0.0%	Grant

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EPC-16-012 Power and Water Saving Advanced Hybrid Air/Wet Cooling System	Pre-existing intellectual property identified in agreement EPC-16-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Altex Technologies Corporation	Group 1: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	The hybrid cooling system is estimated to reduce fan power through low pressure drop characteristics and save water by only using water evaporation when ambient air temperatures are high. Compared to conventional condensers, the AHHEX condenser has a 100 percent higher volumetric heat transfer coefficient and 40 percent lower pressure drop per air flow length. These characteristics reduce the heat exchanger volume, weight and cost and also reduce fan power cost.	1f, 1h, 4a, 4c	Testing for the hybrid heat exchanger and parameter optimization was completed and final report was submitted and is under division review. Based on test data, it was determined that AHHEX can reduce evaporative cooler yearly water use by up to 98.7 percent for a 170-ton example cooling system installed in Oakland. The water savings per year for Oakland would be 2.1 MG/year, which is within the range of the project goal. In addition, the AHHEX fan power reduction was estimated at 28,499 kW-h/year. While the test system capacity was an order of magnitude smaller than the targeted markets, the AHHEX modular-panel approach builds capacity by duplicating the panels and connecting them in parallel to the larger chiller. Therefore, the data obtained on the AHHEX condenser tested in this effort can be directly applied to full-scale commercial and industrial condensers.
EPC-16-013 Integrating Smart Ceiling Fans and Communicating Thermostats to Provide Energy-Efficient Comfort	Pre-existing intellectual property identified in agreement EPC-16-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	39 out of 39 bidders	The Regents of the University of California on behalf of the Berkeley campus	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Air movement, such as through ceiling fans, can cool a person indoors in a similar manner as lowering the temperature, but uses only a tiny fraction of the energy required by HVAC systems. New smart ceiling fans, using only 1-8 watts (compared to 2000-3500 watts for the typical 1.5-3 ton air conditioning system) and producing 1.5 to 2 mph air movement near building's occupants, can offset a 6 degree Fahrenheit increase in indoor air temperature. This improves the occupant's comfort and perceived air quality while substantially decreasing energy consumption. Allowing higher indoor temperatures reduces a building's total HVAC energy by an average of 5% per degree Fahrenheit, and even greater in climate zones where natural ventilation or evaporative cooling systems are used instead of compressor-based cooling, or where there are a large number of airside economizer hours (such as California).	1f, 1h, 3a, 3e, 4a	The research team installed 99 smart ceiling fans and learning thermostats/ sensors in offices, community rooms, and homes in low income housing developments in four Central Valley locations. The fans act as the first stage of cooling, providing comfort and instant control to the occupants. As temperatures rise indoors, the fans gradually speed up. The air conditioning system only starts running when the indoor temperature is substantially higher (78 or 80 degrees Fahrenheit) than usual thermostat settings (70-75 degrees Fahrenheit). The team completed monitoring and collecting data from all sites, and currently analyzing the data. In addition, the team is currently working on the Fan Design Tool and lab testing for ASHRAE 2016 d.
EPC-16-014 A New Solution to California's Energy and Water Challenges: Reducing the Cost of Desalination and Increasing Water Reuse	Pre-existing intellectual property identified in agreement EPC-16-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 35 bidders	Lawrence Livermore National Laboratory	Group 1: Ranked # 6	N/A	N/A	Yes; Calif Based Entity	The FTE-CD technology has the potential of reducing the cost and energy use associated with desalinating water with low to moderate salt content and will represent an advancement over current RO technology. This can increase the potential to increase water recycling and reuse at the community or industrial level, which could reduce the need to procure and transport fresh water sources. Also, this advanced FTE-CD technology is small and flexible which means that it can be customized to the scale needed for each community or industry, thereby increasing a community's water reuse potential which can increase drought resilience for the state.	1f, 1h, 4d	Recipient developed and tested a new operation mode of electrodes (called batch mode) and cell modules before deployment to Delta Diablo. Preliminary testing shows the potential to meet salt removal and productivity targets while reducing flow efficiency losses caused by undesired mixing of desalted water and feed water. Using the optimized electrodes, recipient demonstrated the ability to achieve desalination targets of 500 ppm tds removal with > 70% water recovery using Delta Diablo water samples. Recipient also evaluated a novel charging circuitry design that takes advantage of the large inherent capacity of the cells to eliminate the need for AC-DC converters, thus simplifying the design and lowering cost.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-015 Los Angeles Regional Energy Innovation Cluster	Market Facilitation	This project establishes the Los Angeles Regional Energy Innovation Cluster to act as a regional hub of the clean energy ecosystem and to give promising clean energy entrepreneurs in Los Angeles, Orange, Santa Barbara, and Ventura counties direct access to the region's top technical, business, outreach, and commercialization support services. This project assesses and addresses the region's energy needs by making use of and expanding resources for entrepreneurs and startups, including facilities, coaching, business support, speaking and networking engagements, and information about funding opportunities, all through connections facilitated by the Los Angeles Cleantech Incubator.	8/10/2016	No	Demand-side Management	$4,999,247	$4,999,247	$1,130,999	N/A	$1,130,999	$541,645	$600,000	California State University, Long Beach Research Foundation; Southern California Edison; Community Environmental Council; California State University, Northridge; Economic Development Corporation of Los Angeles County; California State Polytechnic University Pomona; Los Angeles Cleantech Incubator; Los Angeles Cleantech Incubator; Los Angeles County Office of Sustainability; Sustain Southern California; CSU Dominguez Hills; CSU Los Angeles; CSU Channel Islands; LA Business Technology Center; CSU Water	$3,658,099	42.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-016 Commercializing a Disruptively Low Cost Solar Collector	Applied Research and Development	This project has developed a low cost Concentrated Solar Power (CSP) collector to advance the market readiness of this technology. Hyperlight's CSP collector is based on the linear Fresnel reflector (LFR) and is able to make cost reductions through breakthroughs in materials, design, manufacturing, and installation. A major innovation of the system involves use of mirrors attached to UV stabilized and low-cost plastic tubes that are mounted on a sealed water bed foundation. The project has developed: (1) a single 1,000 square foot module used for lifecycle testing and validation of upgraded design elements; (2) a one-half acre system for pilot testing and demonstration; and (3) a front end engineering design study to establish the feasibility and requirements to scale the system up to ten acres and to co-locate with other renewable energy such as a geothermal facility. EPIC funds are being used as cost share funding to Hyperlight's $1.5 million grant from the US DOE.	10/19/2016	No	Generation	$750,000	$750,000	$747,342	N/A	$747,342	$177,896	$2,252,694	None	$0	0.0%	Grant

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EPC-16-015 Los Angeles Regional Energy Innovation Cluster	Pre-existing intellectual property identified in agreement EPC-16-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	2 out of 2 bidders	Los Angeles Cleantech Incubator	Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will benefit California IOU electricity ratepayers through the increased probability of commercialization and deployment of a portfolio of technologies that can reduce electricity costs, decrease peak demand, and improve system reliability and safety. This project will also support technologies based on the regional energy market needs and engage a diverse group of clean energy stakeholders to provide the support, network, and resources needed for accelerated clean energy commercialization.	2a, 3e	In 2018, the LA Regional Energy Innovation Cluster accepted its third cohort of portfolio companies to receive services, for a total of twenty-six startups who have engaged with this program to date. The program will continue to provide important technical and business services such as speaking and networking opportunities, access to business development resources, awareness of funding opportunities, and connections to local energy stakeholders. The program also recently off-boarded startups from its first cohort. The program helped these startups meet critical milestones, including advancement in technology readiness, expanded customer base and partnerships, increased staff, and follow-on funding. As of June 2018, startups receiving services from this program have received $9,376,000 in private follow-on funding and $1,348,000 in public follow-on funding.
EPC-16-016 Commercializing a Disruptively Low Cost Solar Collector	Pre-existing intellectual property identified in agreement EPC-16-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Hyperlight Energy	N/A ****	N/A	N/A	Yes; Calif Based Entity	The project will support technological development by advancing a low-cost CSP collector to commercial availability. In addition to the value of demonstrating the collector through the physical installation, the front end design study and the availability of this low cost collector could inform geothermal power plant owners on the potential to use this innovative system to boost the output of their plants and provide more renewable energy to the grid. The resulting increase in heat transfer fluid temperature from 200 to 300 C expands the market for this technology from food processing to biofuel process plants and petroleum refining.	2a, 4a	A prototype reflector of 20 feet by 50 feet was tested to 10,000 cycles representing a 30-year lifetime, and results of the testing showed minimal degradation. The pilot system has been operating as designed. Total system annual solar-to-thermal efficiency of 1/2 acre module plant was in the range of 60% to 85%. An important milestone achieved in this project is the mass manufacture and installation of the tube structural components required to achieve cost-savings. This project was completed in March 2019. Hyperlight energy will design and install this technology, at Saputo Cheese plant in Tulare to convert solar energy into supplemental heat for thermal processes required to process milk into cheese. In addition, this technology has a good chance of utilization to boost output of geothermal plants.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-017 Maximizing Energy Efficiency and Reducing Bio-solids Waste from New Anaerobic Wastewater Treatment Technology	Technology Demonstration and Deployment	This project is demonstrating the elimination of aeration and its high energy demands as part of secondary water treatment at the Silicon Valley Clean Water wastewater treatment facility using a novel staged Anaerobic Fluidized Bed Membrane Bioreactor (SAF-MBR). This System is projected to generate 30 percent less bio-solids than conventional systems that require aeration. This project also seeks to demonstrate the potential for development of a new high quality local water supply through non-potable and advanced potable reuse treatment trains that eliminate process steps that normally precede the use of reverse osmosis.	10/19/2016	No	Demand-side Management	$1,999,962	$1,999,962	$288,685	N/A	$288,685	$327,386	$0	Leland Stanford Junior University; Santa Clara Valley Water District; Silicon Valley Clean Water; GE Water; LG Water Solutions	$1,219,943	37.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-018 Biological Double-Efficiency Process as an Advanced Wastewater Treatment Method to Achieve Substantial Energy and Water Savings	Technology Demonstration and Deployment	This project is demonstrating an efficiency technology that targets one of the major energy using steps in wastewater treatment. The Biological Double Efficiency Process (BDP) combines state of the art, easy to maintain aeration technology, airlift circulation/dilution technology, and an integrated all-in-one bioreactor technology to replace the separate anoxic and aerobic tanks associated with secondary clarifiers. The BDP is based on simultaneous nitrification/denitrification principles.	11/9/2016	No	Demand-side Management	$1,565,400	$1,565,400	$1,027,068	N/A	$1,027,068	$15,486	$0	BDP Technologies	$330,904	17.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-019 21st Century Solutions for 20th Century Wind Projects	Applied Research and Development	This project aimed to develop inexpensive, standardized turbine upgrades that will allow aged turbines to behave more similarly to modern turbines by dispatching on/off when it is beneficial. The upgrade was a low-cost, robust, wireless communication and control system. The project included installation of wireless communications and a field demonstration of the turbine upgrades and the forecasting algorithm at an operating wind plant in collaboration with CAISO and wind plant owners. The team conducted a field test at a wind farm in the Tehachapi region.	3/8/2017	No	Generation	$810,438	$810,438	$672,149	N/A	$672,149	$322,793	$0	Department of Mechanical and Aerospace Engineering - UC Davis	$124,916	13.4%	Grant

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EPC-16-017 Maximizing Energy Efficiency and Reducing Bio-solids Waste from New Anaerobic Wastewater Treatment Technology	Pre-existing intellectual property identified in agreement EPC-16-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	8 out of 8 bidders	Silicon Valley Clean Water	Ranked # 1	N/A	N/A	No	This project has the potential to lower energy costs of wastewater treatment and water recycling. The advanced technology used in this project is the Staged Anaerobic Fluidized Bed Membrane Reactor (SAFBMR) which eliminates the aeration stage of wastewater treatment. The aeration stage is one of the most energy intensive steps in wastewater treatment. The SAFBMR also has the potential to reduce operation and maintenance costs because bio-solids waste, which typically requires off-site disposal, is reduced, and the effluent does not require the typical microfiltration pre-treatment step prior to the reverse osmosis systems.	1f, 1h, 4a, 4c, 4e	The Research Team has finalized and submitted the Benchmark Report characterizing the performance and costs of existing systems used to treat wastewater for water reclamation and reuse. The design of the Staged Anaerobic Fluidized Bed Membrane Bioreactor has been completed. The contractor was chosen to construct the project at Silicon Valley Clean Water in May 2019. Installation is expected to be completed in 2020. A Technical Advisory Committee meeting and a wastewater workshop were hosted by the CEC in November.
EPC-16-018 Biological Double-Efficiency Process as an Advanced Wastewater Treatment Method to Achieve Substantial Energy and Water Savings	Pre-existing intellectual property identified in agreement EPC-16-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	8 out of 8 bidders	BDP Technologies	Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The innovative BDP technology has the potential to provide substantial energy savings to wastewater treatment plants, including reducing 50 percent of the aeration required for secondary treatment, thus decreasing electrical energy requirements and greatly improves oxygen transfer efficiency to 48-52 percent compared to 20-30 percent in conventional technologies.	1f, 1h	The drilling of the Basin was completed and the recipient is revising the electrical plan per owner specifications. Construction is As of 12/13/2019 all monthly reports have been submitted. Paperwork for the amendment have been submitted and accepted 12/3/2019. Only one disputed invoice remaining.expected to be completed by the end of 2018. The recipient is on budget and schedule and is working on securing the air and water permits.
EPC-16-019 21st Century Solutions for 20th Century Wind Projects	Pre-existing intellectual property identified in agreement EPC-16-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Regents of University of California, Davis	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The innovative, real-time dispatch system for legacy turbines and implementation of a low-cost, robust form of remote communication and control developed under this agreement addressed the inability to efficiently and quickly on and off dispatch turbines when grid and market conditions demand. The project delivered a low cost standardized communication and control system for aged turbines capable of remote on/off dispatch, and created a grid, market, and weather forecasting system to enable automated dispatching of turbines in response to oversupply and low/no wind conditions.	1c, 3a, 3f, 4a, 5c	Through development of the innovative, real-time dispatch system for legacy turbines and implementation of a low-cost, robust form of remote communication and control, this project addressed a key technical barrier for legacy wind plants to efficiently and quickly dispatch turbines on or off as grid and market conditions demand. The economic analysis found that a properly-sized energy storage system has the potential to reduce peak loads and associated demand charges, with a payback period of three to four years. The remote dispatch system and forecast algorithm demonstrated successful operation during a three-month field test involving nine turbines at a wind plant in Tehachapi, California and the cost of the prototype control system was reduced by 82% compared to the cost of a similar commercial system. Information on the remote dispatch system and forecast algorithm are open-source.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-020 Recovery of Lithium from Geothermal Brines	Applied Research and Development	This project demonstrated a cost-effective integrated process for the recovery of lithium from geothermal brines based on: (1) new high-capacity selective composite sorbents comprised of inorganic lithium-ion sieves and lithium-ion-imprinted polymers; and (2) a new sorbent regeneration process using eco-friendly carbon dioxide/carbonic acid that leads to the direct formation of high-purity lithium carbonate (Li2CO3). Compared to traditional methods of Li recovery from brines, the high-capacity selective sorbents and their regeneration process are expected to lower the cost of Li production by enabling online separation with higher recovery efficiency, using smaller volumes of sorbents, and minimizing processing time. The project demonstrated a laboratory-scale integrated separation process for the production of high-purity Li2CO3 from geothermal brines.	12/14/2016	No	Generation	$873,387	$873,387	$873,387	N/A	$873,387	$452,445	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-021 High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network	Applied Research and Development	This project advances the current state for imaging subsurface flow paths, barriers, and heterogeneity in operating geothermal reservoirs through an integrated approach that combines the recent development of low-cost, dense seismic networks together with established state-of-the-art micro-earthquake imaging algorithms and rock physics concepts. The technical advancement of this project is the integration of these components into a system that can be cost-effectively, reliably and routinely deployed in operating geothermal fields to image the movement of fluids in space and time with high-resolution and fast-turnaround time from data collection, to processing, to imaging, to rock physics interpretations.	12/14/2016	No	Generation	$1,672,639	$1,672,639	$1,260,000	N/A	$1,260,000	$528,896	$0	Jarpe Data Solutions	$50,000	2.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-022 Comprehensive Physical-Chemical Modeling to Reduce Risks and Costs of Flexible Geothermal Energy Production	Applied Research and Development	This project seeks to address the specific challenges of base-load and flexible-mode geothermal production, including wellbore and reservoir integrity, scaling, and corrosion. An improved model is being developed and applied to better understand these issues. Flexible mode production typically includes daily cycles in production rate that result in extraordinary stress on the wellbore and reservoir system. The modeling and assessment is being conducted to predict short- and long-term impacts of flexible-mode production on liquid-dominant geothermal reservoir systems representative in California as well as on the site-specific vapor-dominated Geysers Geothermal Field.	12/14/2016	No	Grid Operations/ Market Design	$999,032	$999,032	$660,000	N/A	$660,000	$480,995	$0	None	$0	0.0%	Grant

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EPC-16-020 Recovery of Lithium from Geothermal Brines	Pre-existing intellectual property identified in agreement EPC-16-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	SRI International	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will lead to technological advancement by enabling co-production of power and high-value metals from geothermal resources. The co-production of metals will improve the economic viability of geothermal power production, therefore increasing the penetration of geothermal renewable energy.	2a, 3g	The project successfully demonstrated the laboratory-scale Integrated Lithium Capture System. The recipient has licensed the technology to ExSorbtion, Inc. who will be pursuing commercialization.
EPC-16-021 High-Resolution Imaging of Geothermal Flow Paths Using a Cost Effective Dense Seismic Network	Pre-existing intellectual property identified in agreement EPC-16-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will provide tools to help geothermal operations to be more productive. It will demonstrate the advantages of a micro-earthquake imaging system that uses a dense network of seismic stations and automated processing to perform fast-turnaround, high-resolution imaging of fluid movement in producing geothermal reservoirs.	1c, 2a, 3a, 3b	This project team completed the processing of seismic data from initial hypocenter locations. The team completed creation of a finite difference benchmark dataset for use in validation of hypocenter location accuracy. It also conducted joint tomography for 3D velocity structure and hypocenter locations for a 17,000+ event dataset. While the one-year data acquisition campaign was completed in June 2019, the 91-station network remains in place for future operations and, time permitting, for additional data collection and tomographic imaging.
EPC-16-022 Comprehensive Physical-Chemical Modeling to Reduce Risks and Costs of Flexible Geothermal Energy Production	Pre-existing intellectual property identified in agreement EPC-16-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project will lead to technological advancement by providing modeling tools that can be used by geothermal operators to better understand the impacts of flexible-mode production on the reservoir-wellbore system. This knowledge will allow the development of power plant and control technologies to enable geothermal power plants to operate in different variable modes, and to be both a base-load and flexible renewable resource.	2a, 3a, 5a, 5f	The modeling tools have been completed. The project completed modeling simulations for base-load and flexible production for liquid dominant geothermal systems. The project team has modeling the Geysers using pilot test data and is in the process of acquiring data from other geothermal systems to model as well.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-024 San Gabriel Valley Water Company "Plug and Play" In-Conduit Hydropower Development Project (SGVWC Project)	Applied Research and Development	The San Gabriel "Plug and Play" In-Conduit Hydropower Development Project aims to design, develop and demonstrate a modular, cost-effective in-conduit hydroelectric system designed for the sub-100-kW in-conduit hydroelectric market that will reduce civil, mechanical, electrical, and interconnection costs. The San Gabriel Project includes a new 73 kW modular "plug and play" in-conduit hydroelectric station at a space-constrained site in an urban, potable water system that will provide an estimated 381 megawatt-hours (MWh) of renewable generation per year, while also providing a model that can be deployed to many undeveloped, small sub-100 kW in-conduit sites throughout the state.	1/25/2017	No	Generation	$500,000	$500,000	$449,989	N/A	$449,989	$13,082	$0	NLine Energy, Inc.; San Gabriel Valley Water Company	$782,000	61.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-025 Comprehensive Assessment, Tools and Resources for Advancing In-Conduit Hydropower in California	Applied Research and Development	This project conducted a comprehensive assessment of in-conduit hydropower generation potential in California and developed a guidebook and a business case assessment tool that assist municipal, agricultural, and industrial water purveyors with the cost effective implementation of in-conduit hydropower generation projects. The proposed guidebook and the business case assessment tool will provide invaluable knowledge base for municipal (water and wastewater), agricultural and industrial agencies that are considering capturing hydrokinetic/hydrostatic energy and integrating in-conduit hydropower into the existing energy mix. The Business Case Assessment Tool will assist users with building a business case for implementation of an in-conduit hydropower project, providing qualitative and quantitative guidance on the system configuration and site characteristics for fit-for-purpose applications, and estimating preliminary life cycle cost, LCOE, and GHG emissions.	1/25/2017	No	Generation	$400,000	$400,000	$399,998	N/A	$399,998	$121,338	$0	Leland Stanford Junior University; NLine Energy, Inc.; Stantec Consulting Services Inc.	$83,018	17.2%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-026 Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants	Applied Research and Development	This project develops and pilot tests integrated control strategies for demand response (DR) at two demonstration sites in California: a water pumping station and an industrial refrigerated warehouse. Both test sites have built-in energy storage capabilities. The pumping station stores energy in water pumped uphill, while the refrigerated warehouse stores energy as thermal mass in frozen food. The capacity for storage allows for temporary shed, shift or adjustment in power demand. The proposed technology will integrate controls, energy cost, historic load data, and tariff information to allow for optimized demand response. These control strategies are expected to be practical and technically feasible.	5/10/2017	No	Demand-side Management	$3,000,000	$3,000,000	$798,335	N/A	$798,335	$888,920	$0	Electric Power Research Institute, Inc.; San Diego Gas & Electric Company; Southern California Edison	$465,000	13.4%	Grant

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EPC-16-024 San Gabriel Valley Water Company "Plug and Play" In-Conduit Hydropower Development Project (SGVWC Project)	Pre-existing intellectual property identified in agreement EPC-16-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	San Gabriel Valley Water Company	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project will recover wasted energy from an existing pressure-reducing station. The recipient estimates there to be about 120 similar-sized pressure reducing opportunities within California, representing 9,000 kilowatts that will become economically viable if the project is able to meet its cost reduction goals.	1a, 1b, 2a	The project completed December 2019. To ensure that San Gabriel Valley Water Company can meet peak water demand in the summer time, construction began in the fall of 2018 and the system was commissioned in the summer of 2019. Testing and operation activities were conducted and will be included in the final report.
EPC-16-025 Comprehensive Assessment, Tools and Resources for Advancing In-Conduit Hydropower in California	Pre-existing intellectual property identified in agreement EPC-16-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Stantec Consulting Services Inc.	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Newer in-conduit hydroelectric turbine technology research and development has not been adequately covered in any published guidebook. Available guidebooks do not include many novel technologies and lack technical information related to performance, equipment, siting criteria, engineering design considerations, and costs that will assist California's stakeholders in determining which in-conduit hydroelectric technologies are best suited for a particular site.	1a, 3a, 3b	The project team estimated the in-conduit hydropower potential in California by analyzing data collected by NLine Energy, results from a questionnaire prepared by the team and distributed to various water agencies, as well as crossing data from USGS, DWR and SWRCB database. The estimate concluded that while there is at-least 343 MW of installed in-conduit hydropower facilities in California as of 2017, there is 414 MW of remaining potential. The team also conducted eight case studies, which identified that small in-conduit hydropower projects should consider multiple scenarios at the feasibility stage to investigate different hydrologic conditions, and interconnection costs can vary considerably. The final report and assessment tool were presented in a webinar attended by more than 200 people.
EPC-16-026 Develop and Pilot Test Flexible Demand Response Control Strategies for Water Pumping Stations and Industrial Refrigeration Plants	Pre-existing intellectual property identified in agreement EPC-16-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Electric Power Research Institute, Inc.	Phase 1 Group 2: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	This project develops technology that will enable industrial customers to provide automated DR service to the grid including fast ramping, operating reserves, frequency regulation, and peak load reduction in support of California's goals for DR and energy efficiency as well as renewable integration and greenhouse gas emissions reduction.	1g	Both the water and refrigeration projects will shortly start data collection. The collection of water pumping data was delayed because the water agency, CalWater, needed to approve the software platform for data transfer and collection. The recipient is now on track to collect data through fall 2020. The refrigeration project was delayed because of a site change from a refrigerated warehouse in Long Beach to Mira Loma. Currently, the recipient is on track to collect data and conduct demand response analysis for the fall/early winter 2020 period. The recipient continues to evaluate the controls capabilities based on the load profiles for both the refrigeration and water facilities.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-027 Facilitating On-farm Participation in Energy Demand Management Programs	Applied Research and Development	This project develops a management tool for optimizing irrigation at 10 farms in California. The sites have varied water requirements, growing a mix of almonds and alfalfa. The project is validating a pre-commercial water management system that allows irrigators to have more flexibility over when they irrigate and use energy. Instead of adding water whenever the soil is dry, this system will manage plant stress so that water can be delivered when costs are low and when needed by the plant. The purpose of the management technology is to enable irrigators to participate in utility incentive programs offering benefits to customers who can shift their energy demand. This management approach would enable participation in utility demand response, time of use, and automated demand response programs.	3/8/2017	No	Demand-side Management	$1,588,872	$1,588,872	$868,986	N/A	$868,986	$153,035	$0	Irrigation for the Future, Inc.	$126,663	7.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-028 Irvine Ranch Water District Load Shifting and Demand Response Pilot Project	Applied Research and Development	This project develops, tests, and validates a load-shifting optimization platform to reduce energy use and demand charges in the water sector. The platform advances pre-commercial demand response technologies to reduce: peak demand, energy use, and operational costs. The platform integrates advanced real-time monitoring, automated load shifting control, energy storage, and a pre-commercial cost optimization platform. Data generated by the project will validate the approach and identify best practices for increasing water sector participation in demand response programs.	3/8/2017	No	Demand-side Management	$1,403,465	$1,403,465	$479,453	N/A	$479,453	$832,615	$0	Advanced Microgrid Solutions, Inc.	$760,427	35.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-029 Water/Energy Bank Proof-of-Concept	Applied Research and Development	This proof of concept study evaluated the feasibility of using groundwater storage and cycling surface reservoirs to shift the State Water Project's Southern California water deliveries to non-summer months to reduce summer electric grid peak demand. Shifting the timing of water deliveries could reduce solar and wind power over-generation risk during non-summer months when renewable energy is in surplus. This project investigated the technical, institutional, legal and economic feasibility of implementing a guaranteed water delivery shift and develop demand response and load shifting tools and strategies to manage peak load and demand and thereby reduce energy costs in the water sector.	3/8/2017	No	Demand-side Management	$1,000,000	$1,000,000	$824,854	N/A	$824,854	$150,000	$0	Antelope Valley Water Storage, LLC	$225,000	18.4%	Grant

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EPC-16-027 Facilitating On-farm Participation in Energy Demand Management Programs	Pre-existing intellectual property identified in agreement EPC-16-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Irrigation for the Future, Inc.	Phase 1 Group 2: Ranked # 4	N/A	N/A	No	The project results in testing an irrigation management system to facilitate use of partial irrigation strategies, enabling flexible energy load control. This will allow irrigators to participate in utility demand response and time of use programs while providing flexibility to the grid.	1b, 1e, 1f, 1g, 2a, 4c	The research team continues to collect in-season measurement and observations at the cooperating farms in preparation for the third season field trial of the automated irrigation management system, Irrigation Management Online (IMO). This system employs automated data integration that can generate updated irrigation schedules which is sent to the grower on-demand via the updated IMO interface. The IMO system informs the growers of the water use and yield reduction consequences of participating in any particular DR or Auto DR event.
EPC-16-028 Irvine Ranch Water District Load Shifting and Demand Response Pilot Project	Pre-existing intellectual property identified in agreement EPC-16-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Advanced Microgrid Solutions, Inc.	Phase 1 Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity, Woman Own	The project integrates several pre-commercial and commercial technologies into a platform that enables operational equipment and energy storage resources to respond automatically to energy price signals. The integrated approach promotes greater participation in demand reduction events, including the ability to participate without prior-day notice.	1e, 1f, 1g, 1h, 4a	The project team has conducted energy audits of the pilot sites, modeled facility load profiles, and assessed which tariffs are most advantageous for reducing peak demand and energy. The largest pilot sites are on new tariffs that allow participation in the local capacity resource program. Design, engineering and installation of battery storage systems at six sites is complete. Opportunities for load control at the 11 sites have been developed and tariff analysis incorporated to quantify the impact of battery storage and operational load control with eligible demand response programs. The project team has reviewed the potential opportunities with the Irvine Ranch Water District. The water district is currently considering which operational load control measures to implement.
EPC-16-029 Water/Energy Bank Proof-of-Concept	Pre-existing intellectual property identified in agreement EPC-16-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Antelope Valley Water Storage, LLC	Phase 1 Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project could lower peak demand on the electric grid during Summer months when power demand is at its highest levels. This will increase the reliability of the electric grid system, reduce the use of peaker plants that operate on fossil fuels to meet system demand and operating margins, and lower Department of Water Resource's water transport costs by shifting electric demand to non-summer months when demand and energy rates are lower.	1e, 1f, 4a, 5b	This project was completed in July 2019. The technical and final reports are complete. Using the Edmonston pumping plant for the analysis, implementation of the Recipient's recommendations would lead to an average peak load reduction of 60 MW from July to September based on a normal water year. A notable finding is the possibility of converting the Water-Energy Bank into an energy neutral operation through the use of 40 MW of solar arrays and 5 MW of hydropower. The Recipient presented the Water-Energy Bank concept at the Demand Response & Distributed Energy Resources World Forum on October 16, 2018 and American Water Works Association CA-NV spring conference The Recipient also plans to publish results in journals and disseminate results at future conferences after the end of the grant period.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-030 Enabling Energy Efficient Data Centers in Smart Power Distribution Systems	Applied Research and Development	This project is researching and testing technologies that improve data center energy efficiency at three different levels in a smart power distribution system. The technologies include increasing server energy efficiency, through coordinated deep sleep and dynamic voltage-frequency scaling (DVFS); data center workload balancing through phase and load balancing across multiple servers in a data center; and geographical workload balancing through phase/load balancing in a single or multiple power distribution network or feeder.	3/8/2017	No	Demand-side Management	$1,783,118	$1,783,118	$633,262	N/A	$633,262	$306,631	$0	San Jose State Research Foundation; The Regents of the University of California (UC Riverside)	$297,064	14.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-031 VOLTTRON Testing Tool Kit	Applied Research and Development	This federal cost share project demonstrates the benefits of the VOLTTRON platform for DER management through the testing of the VOLTTRON Testing Tool Kit. VOLTTRON is a US Department of Energy funded open source platform intended to provide a software base for integrating management of energy demand in buildings, distributed energy resources, and the electrical grid. The tool kit includes simulation test suites, a platform monitoring and debugging tool, and more extensive database support to promote wider adoption of VOLTTRON platform beyond its original set of developers. By lowering implementation costs and adding easy adoption features, the tool kit encourages adoption by other users, including organizations and private entities seeking to develop DER integration projects.	3/8/2017	No	Demand-side Management	$70,000	$70,000	$70,000	N/A	$70,000	$28,501	$805,000	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-032 Leading in Los Angeles: Demonstrating Scalable Emerging Energy Efficient Technologies for Integrated Facade, Lighting and Plug Loads	Technology Demonstration and Deployment	The recipient is demonstrating and validating new retrofit package solutions from laboratory pre-testing through field demonstrations in existing government-owned commercial buildings. The solution sets, dubbed "INTER", are comprised of shading products from Rollease Acmeda and lighting and plug load systems and integrated controls, including HVAC systems, from Enlighted. The technologies can be combined and customized to suit a variety of building types and spaces, resulting in an estimated whole building energy reduction of 20 to 32 percent. Beginning in the Los Angeles basin, the team is leveraging existing market connections to increase and accelerate market adoption of these retrofit solution sets to maximize the potential energy and carbon savings, first in the region and ultimately, throughout California.	3/8/2017	No	Demand-side Management	$4,981,000	$4,981,000	$3,491,017	N/A	$3,491,017	$1,767,847	$0	Southern California Edison; CSU Dominguez Hills; Lawrence Berkeley National Laboratory; Enlighted Inc.; Rollease Acmeda, Inc.; Delos; BeMO USA Corp; City of Santa Ana; Daintree	$1,725,500	25.7%	Grant

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EPC-16-030 Enabling Energy Efficient Data Centers in Smart Power Distribution Systems	Pre-existing intellectual property identified in agreement EPC-16-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Regents of the University of California, Riverside Campus	Phase 1 Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	Data centers are a major consumer of electricity. In the PG&E service territory, peak demand of data centers is around 500 MW, representing 2.5% of peak load consumption. The energy use from data centers is expected to increase by 4% annually in the next 5-10 years. The development of agile energy efficiency solutions for data centers is needed. This project provides unique software based solutions, rather than hardware solutions, to reduce electricity consumption by data centers through deep sleep and dynamic voltage frequency scaling, peak efficiency scheduling and spatial workload scheduling. If successful, potential electricity savings of up to 35% could result.	1f, 1g, 2a	The project team has completed the modeling of the Peak Efficiency Scheduling Algorithm and have preliminary average results of approximately 15% overall energy usage reduction. The project team is now working on development of the load migration and the demand response algorithms. Early examples show nearly perfect compliance. They can effectively move their demand within milliseconds. They accomplish this by starting with a base load then adding dummy loads to match artificially demand requests.
EPC-16-031 VOLTTRON Testing Tool Kit	Pre-existing intellectual property identified in agreement EPC-16-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	SLAC National Accelerator Laboratory	N/A ****	N/A	N/A	Yes; Calif Based Entity	Communication of DERs with grid operators is critical for successful utilization of distributed energy resources. DOE developed the VOLTTRON platform to facilitate such communication. However, the platform is in its early stages and requires additional support and an expanded user base to become widely adopted. The VOLTTRON Testing Tool Kit provides new tools to confidently run a high qualify open source project. All knowledge gained and software written will be pushed to GitHub for open source use. With the testing tool kit, VOLTTRON becomes a more effective platform for DER management. This will enable higher utilization of DERs in support of the state's renewable energy and GHG reduction goals.	1d, 1e, 1f, 1g, 1h, 4a, 5b	The project objective was to facilitate adoption and demonstrate the benefits of the VOLTTON platform for DER management systems. The project team set out to increase the VOLTTRON user community and increase its diversity in order to move VOLTTRON closer to reaching a critical mass needed for widespread market adoption. The project team created awareness among the DER industry and utilities through the project and added several new companies that engaged with the VOLTTON. The project team found that the DER industry is further along in their integration effort and switching to VOLTTON could cost them significant effort and time. However, the new capabilities added with this project should help speed up the newcomers' development efforts should they chose to utilize VOLTRTRON. All tools developed contributed back to the VOLTTRON open source repository on GitHub.
EPC-16-032 Leading in Los Angeles: Demonstrating Scalable Emerging Energy Efficient Technologies for Integrated Facade, Lighting and Plug Loads	Pre-existing intellectual property identified in agreement EPC-16-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 8 out of 10 bidders	New Buildings Institute, Inc.	Phase 1 Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project creates a holistic, low-barrier integrated retrofit solution for significant energy savings. The scalable energy retrofit solution will be demonstrated in municipal government buildings but is also applicable to other commercial and residential buildings and to new construction and existing buildings. Installation does not require specialized training. The integration of technologies can produce higher savings than individual technologies operated in isolation. Creating building retrofit solutions that are least disruptive to building occupants while solving energy, occupant and owner issues are key to providing solutions that will support California's statewide zero net energy and existing building goals.	1f, 1h	In 2019, the recipient completed testing at FLEXLAB of an integrated suite retrofits for commercial buildings, including shading products from Rollease Acmeda and lighting and plug load systems and controls from Enlighted and produced a testing report that included measurement plan and test results. The test results covered summer, fall and winter. The integrated retrofits resulted in savings of 62% in the winter and 76% in the summer, relative to the existing building baseline. HVAC load savings were found in the cooling mode and were similar to the lighting energy savings. The project was discussed at the 2019 Behavior, Energy and Climate Change Conference. The team completed installations of the integrated retrofits in buildings located in the city of Santa Ana and CSU Dominguez Hills. The project was presented at the 2019 Behavior, Energy and Climate Change Conference.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-033 Internet of Things and Ubiquitous Sensing in University Building Energy Management: Design Optimization and Technology Demonstration	Technology Demonstration and Deployment	This project develops and evaluates a pre-commercial energy management system at a building on the CSU Long Beach campus. The research uses energy efficient technologies with internet of things (IoT) controls in order to optimize load operation, load leveling, and peak shaving. IoT solutions can provide more granular data to better target technology and efficiency solutions. The advancements in monitoring and controls from this project will enable deployment of similar systems at other academic facilities in California.	3/8/2017	No	Demand-side Management	$2,509,946	$2,509,946	$739,630	N/A	$739,630	$78,271	$0	Regents of the University of California, Riverside Campus; CSU Long Beach Research Foundation; Enlighted Inc.; ControlWorks, Inc.	$1,072,958	29.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-034 Automated Cloud-Based Continuously Optimizing Building Energy Management System	Technology Demonstration and Deployment	This project develops a software platform that helps building energy management systems run more effectively. The Automated Cloud-based Continuously Optimizing Building Energy Management System (ACCO-BEMS) automates and optimizes control of building systems and devices. It is being implemented at Pomona College in 11 buildings on campus, half of which will have ACCO-BEMS as a new building energy management system, the other half will have ACCO-BEMS integrated with the existing system.	3/8/2017	No	Demand-side Management	$2,500,000	$2,500,000	$1,921,915	N/A	$1,921,915	$552,488	$0	Zero Net Energy (ZNE) Alliance; MelRok, LLC	$1,184,891	32.2%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-035 High-Performance Cu-Plating for Heterojunction Silicon Cells, Based on Ultra-Low-Cost Printed Circuit Board (PCB) Technology (Stage II)	Applied Research and Development	This project develops a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing, reducing costs by up to 35%, and increasing cell efficiency by 15%.	4/12/2017	No	Generation	$2,430,000	$2,430,000	$1,711,084	N/A	$1,711,084	$730,620	$9,540,309	None	$0	0.0%	Grant

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EPC-16-033 Internet of Things and Ubiquitous Sensing in University Building Energy Management: Design Optimization and Technology Demonstration	Pre-existing intellectual property identified in agreement EPC-16-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 8 out of 10 bidders	CSU Long Beach Research Foundation	Phase 1 Group 2: Ranked # 2	N/A	N/A	No	The project aims to remove barriers to achieve widespread deployment of state-of-the-art energy management technologies. The project provides California IOUs, academic institutions (universities, including 22 CSU campuses), energy management technology developers, and other stakeholders with an IOT-based energy management platform. Additionally, the project provides a comprehensive example of the potential for large scale deployment, including technical considerations, building performance, energy savings, and non-energy benefits.	1f, 1g, 1h	Amendment was approved and awaiting execution. CSULB has completed the installation of the IoT-based measures, including sensors that enable the energy management system to control new LED lighting, and existing plug loads, and HVAC. The HVAC controls were installed in September 2019 and the team continues to collect data from the HVAC system as well as the IoT EMS system to evaluate the consumption and energy efficiency of the building post-IoT measure installation.
EPC-16-034 Automated Cloud-Based Continuously Optimizing Building Energy Management System	Pre-existing intellectual property identified in agreement EPC-16-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 8 out of 10 bidders	Zero Net Energy (ZNE) Alliance	Phase 1 Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Energy performance monitoring and fault detection diagnostics software is a key technology that must be further enhanced and deployed to overcome barriers to achieving ZNE buildings. A principal barrier to real-time management of energy systems is the many, often incompatible, protocols and interfaces used by energy devices and sensors. These have long represented a barrier to the integration of discrete systems, sensors and actuators necessary to automatically assess and control energy use. This project uses an internet-of-things gateway to communicate with the various energy using devices in the building using their native protocol and interface. The platform uses machine learning to assess real-time building performance and automatically adjust individual devices. The technology eliminates building drift and negates the need for expensive reprogramming or optimization measures.	1f, 1h, 4a	The ACCO BEMS platform is installed at 10 buildings on the Pomona College campus. The HVAC systems have been commissioned and additional sensors and actuators installed. The platform is running fault detection on sensors, actuators and command controls to identify abnormal data streams and detect failures in ventilation equipment, chillers, cooling towers, boilers, pumps and terminal units. Of the approximately 4,000 sensors and actuators evaluated, more than 100 data streams have been positively identified as indicative of problems at the sensor, actuator, or logic level. The fault detection engines use a combination of physics-based rules, and artificial intelligence (AI) based patter recognition to detect failures. The ACCO BEMS platform has successfully identified a number of problems and retrofitting opportunities that would have required costly manual recommissioning to uncover.
EPC-16-035 High-Performance Cu-Plating for Heterojunction Silicon Cells, Based on Ultra-Low-Cost Printed Circuit Board (PCB) Technology (Stage II)	Pre-existing intellectual property identified in agreement EPC-16-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Sunpreme, Inc.	N/A ****	N/A	N/A	Yes; Calif Based Entity	The project is developing a next generation manufacturing tool for low-cost, high-performance copper patterning on solar photovoltaic cells using technologies from printed circuit board manufacturing. This new process will lower electricity-related greenhouse gas (GHG) emissions and improve solar cell efficiency.	1b, 1c, 2a, 3b, 4a	This project was completed in 2019. The research team developed and tested next generation manufacturing at a pilot scale for copper patterning on silicon photovoltaic cells. This includes the following steps: dual-sided exposure for high-throughput wafer patterning, cell development, cell stripping, cell etching and lamination. The project team manufactured solar photovoltaic cells with 24.03% efficiency, performed in-house reliability testing, and received certification from an independent laboratory. Completion of the final project task of integrating the process into a large-scale PV cell factory was inhibited by a lack of additional investment.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-036 Thermoelectric Generator Application and Pilot Test in a Geothermal Field	Applied Research and Development	Thermoelectric Generator (TEG) technologies have the potential to produce geothermal electricity without as much infrastructure (turbines, steam piping, etc.), thus making small-scale production and geothermal-powered microgrids both practicable and affordable. Small (<5 MW) geothermal projects could provide consumers with the same distributed power flexibility provided by solar and wind production with the additional benefit of being a more reliable baseload source of electricity. TEG technologies can also allow geothermal heat to provide balancing and grid support. This project is scaling up a TEG from the watt-level in the lab to a 20 kW unit for demonstration in a geothermal reservoir.	4/12/2017	No	Generation	$1,280,000	$1,280,000	$353,140	N/A	$353,140	$388,589	$0	Leland Stanford Junior University; AltaRock Energy, Inc.	$118,095	8.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-037 The Amador Water Agency In-Conduit Hydropower Development Project (AWA Project)	Applied Research and Development	The goal of this project is to design, test, and demonstrate a 417 kW in-conduit Pelton turbine runner at an existing Pressure Reducing Station (PSR) site located in Ione, California. The project will demonstrate the ability to maximize the wasted energy captured at the station using an improved design of a higher-efficiency Pelton turbine runner specifically designed for small, in-conduit hydroelectric applications to contribute in the integration of in-conduit small hydropower into the existing state energy mix.	4/12/2017	No	Generation	$750,000	$750,000	$596,652	N/A	$596,652	$0	$0	NLine Energy, Inc.; Amador Water Agency	$1,115,000	59.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-038 Use of Indoor Rearing for Head-Starting Desert Tortoises	Applied Research and Development	The project conducts experimental releases of juvenile desert tortoises raised since 2011-2013 and new hatchlings in 2016-2017 to evaluate the trade-offs of head-start duration on post-release survival of desert tortoises. The project team is dividing new hatchlings into two cohorts, raising half of them exclusively outdoors and the other half under a combination of indoor/outdoor rearing, releasing them as 2 year olds, and comparing their post-release survival. Data on the growth and survival of animals in this study provides guidance on the minimum duration of outdoor head-starting and whether indoor head-starting should be pursued in future head-starting programs for desert tortoises. Ultimately, the results of the study can inform the extent to which head-starting both indoors and outdoors is a viable solution for mitigating localized impacts to tortoise populations affected by development for solar energy production facilities.	4/12/2017	No	Generation	$493,089	$493,089	$248,205	N/A	$248,205	$106,461	$400,000	The Regents of the University of California, Davis Campus	$61,119	11.0%	Grant

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EPC-16-036 Thermoelectric Generator Application and Pilot Test in a Geothermal Field	Pre-existing intellectual property identified in agreement EPC-16-036 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	AltaRock Energy, Inc.	Group 1: Ranked # 3	N/A	N/A	No	This project will develop a means to expand use of low temperature and stranded geothermal resources by making small scale production both practicable and affordable.	1a, 1b, 1c, 2a, 3b	The project team deployed two small test units at the geothermal site as a test run. The lessons learned helped the team make improvements to the design and process. Next, the 20 kW unit will be built and deployed. Due to 6-9 months of project delays, the project team is working to expeditiously complete the remaining project implementation steps.
EPC-16-037 The Amador Water Agency In-Conduit Hydropower Development Project (AWA Project)	Pre-existing intellectual property identified in agreement EPC-16-037 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Amador Water Agency	Group 1: Ranked # 2	N/A	N/A	No	The system developed under this project will recover and maximize the capture of wasted energy in a Pressure Reducing Station (PRS); improve the efficiency, performance, and cost of the Pelton turbine technology to capture wasted energy; provide a viable retrofit solution for degrading sites; and help expand small hydropower deployment.	1a, 1b, 1c, 3a, 3b, 4a	The project completed the design phase and contracted with Gilkes to manufacture the turbine, which was delivered in the spring of 2019. AWA also procured a general contractor, Central Sierra Electric, to construct the project. Construction of civil works and improvements began in the fall of 2018. Installation of the turbine and balancing of the plant began in late spring of 2019 and continued into the fall of 2019. Commissioning and testing and will begin by March 2020 and the project will be completed by June 2020.
EPC-16-038 Use of Indoor Rearing for Head-Starting Desert Tortoises	Pre-existing intellectual property identified in agreement EPC-16-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Regents of University of California, Davis	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The research will be the first to evaluate the trade-offs in duration of head-starting on post-release survival in the eastern Mojave Desert where numerous solar production facilities have been recently constructed. Because longer head-start periods cost more, finding the optimal head-starting duration will help develop more cost-effective head-starting programs. The research will also evaluate indoor-head-starting. If the increase in size also results in an increase in post-release survival compared to outdoor-reared animals, indoor head-starting could dramatically reduce the costs of rearing animals to releasable size and also increase production of head-starting facilities.	2a, 3a, 3b, 4f, 4g	The research team produced tortoise hatchlings in 2016 and 2017 and assigned them either to the indoor or outdoor experimental groups. The indoor group was raised indoors in their first year and then transitioned to outdoor pens for the second year of their head-starting. All captive tortoises were measured to track their growth rates in different treatments. In September 2018, the team released 78 juvenile tortoises and began post-release monitoring using radio telemetry; the remainder were released in fall 2019. The project team is collaborating closely with a complementary project (EPC-16-053), as well as with U.S. Fish and Wildlife Service and California Department of Fish and Wildlife to develop guidelines and recommendations about the mitigation and recovery strategy. The recipient was granted a no-cost term extension to allow additional monitoring through the summer of 2020.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-039 A Life Cycle Assessment of the Environmental and Human Health Impacts of Emerging Energy Storage Technology Deployment	Applied Research and Development	This project investigates whether flow batteries are a viable option for providing grid energy storage at the large scale, either in place of or alongside lithium-ion battery technology. The researchers are examining a life cycle-based characterization of the environmental impacts and resource usage associated with three chemistries of flow batteries (Vanadium Redox (V2O5), Zinc-Bromide (ZnBr), and Iron-Sodium (FeNa)). Specifically, they are investigating materials use, energy use, and toxic waste outputs of the life cycle phases of each flow battery type, including materials extraction, manufacturing, use, and disposal or recycling as applicable.	4/12/2017	No	Distribution	$600,000	$600,000	$355,367	N/A	$355,367	$98,142	$0	The Regents of the University of California, Irvine	$186,219	23.7%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-040 Assessing Cooling Tower PM2.5 and PM10 Emissions using Advanced Instrumentation, Plume Transects, and Plume Modeling	Applied Research and Development	This project measures PM2.5 and PM10 across the spray drift plume from two power plant cooling towers that use fresh water and brackish water. These measurements are used to develop and validate a model of power plant PM2.5 and PM10 emissions. The end result is a model that power plant operators can use to minimize the PM2.5 and PM10 emissions of brackish water use in cooling towers.	4/12/2017	No	Generation	$700,000	$700,000	$341,793	N/A	$341,793	$108,004	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-041 Benefits and Challenges in Deployment of Low GWP A3 Refrigerants in Residential and Commercial Cooling Equipment	Applied Research and Development	This project develops test procedures and conducts testing for alternative refrigerants to assess flammability and to characterize energy savings. The recipient will also develop a favorability index of end-use market segments and equipment types based on potential GHG savings and commercial adoption feasibility.	4/12/2017	No	Demand-side Management	$500,000	$500,000	$460,000	N/A	$460,000	$221,625	$0	Institute for Governance & Sustainable Development	$500,000	50.0%	Grant

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EPC-16-039 A Life Cycle Assessment of the Environmental and Human Health Impacts of Emerging Energy Storage Technology Deployment	Pre-existing intellectual property identified in agreement EPC-16-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	The Regents of the University of California, Irvine	Group 5: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project provides guidance for California policymakers and planning agencies for selecting emerging energy storage technologies that can facilitate the increased uptake of renewable resources and decarbonization of California's energy system, helping safeguard the environment and public health. This study is a first of its kind for flow battery technology and provides the knowledge base needed for flow batteries to be deployed in a safe and environmentally sensitive manner.	2a, 3e, 4b, 4c, 4d, 4e, 4f, 5d, 5e	The project is well underway. The research team compiled a database for material use, energy use, waste, emissions, and costs associated with three different flow battery chemistries, using the inventory data obtained from three flow battery manufacturing facilities (ESS, UET, Primus Power). Using the database, the research team analyzed environmental impact profiles of different flow battery types, taking into account their effect on and benefits for energy systems under scenarios of increasing renewable resource penetration. In addition, the research team evaluated air quality impacts, impacts on respiratory health, non-cancer toxicity and cancer-related toxicity for each flow battery type for populations in California and submitted reports to the CEC. Moving forward, the research team will perform business case studies for different types of flow batteries.
EPC-16-040 Assessing Cooling Tower PM2.5 and PM10 Emissions using Advanced Instrumentation, Plume Transects, and Plume Modeling	Pre-existing intellectual property identified in agreement EPC-16-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	The Regents of the University of California, Davis Campus	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The research team is using plume measurements from fresh and brackish water cooling towers to develop a model of the droplet and particle size distribution changes in cooling tower plumes as a function of cooling water composition, meteorological conditions, and cooling tower operating parameters. The model will be based on first principles of chemistry and physics and will be validated using the measurement data. The model supports the use of brackish water instead of expensive fresh water, leading to decreased costs for electric utilities and ratepayers and freeing up more fresh water for use in homes, industry, and agriculture in California.	1c, 2a, 3a, 4b, 4c	The research team has completed the design of the instrument package for PM monitoring from cooling towers and has tested two power plants. Since both power plants have a similar amount of TDS in the circulating water, the team identified a third power plant with different TDS levels to test the different behaviors; the team is working with the power plant's operator to schedule the field test.
EPC-16-041 Benefits and Challenges in Deployment of Low GWP A3 Refrigerants in Residential and Commercial Cooling Equipment	Pre-existing intellectual property identified in agreement EPC-16-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Lawrence Berkeley National Laboratory	Group 7: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project is evaluating alternative, low global warming potential (GWP) refrigerants that will also result in increased energy efficiency of cooling equipment. This project will identify current barriers and technical issues, and assess the potential for an expanded set of products which could use low GWP A3 refrigerants. The recipient will (1) develop test procedures for alternative refrigerants for flammability and energy savings characterization and (2) develop a "favorability" index of end-use market segments and equipment types based on potential GHG savings impact and commercial feasibility and adoption. This can help equipment manufacturers with product development and adopt equipment with much lower lifetime GHG emissions. By transitioning to refrigerants with lower GWP, the state will see fewer GHG emissions from commercial and residential buildings over the next 10-30 years.	1f, 1h, 4a	The recipient has prepared test plans to analyze cost savings, energy savings, GHG reductions, and efficacy of the A3 alternatives. There was a change to replace self-contained commercial refrigeration equipment, as their research indicated that manufacturers were already moving towards this direction. Instead, they will research room or window air conditioning units. The recipient has started testing room air conditioning units as well as mini-split and packaged terminal air conditioning units. The team is also performing soft-optimization tests of room air conditioning units to determine unit-level efficiency and capacity. Testing results are expected in April 2020.Their modeling of flammable refrigerants were calibrated and show good agreement with test data. Project end date has been extended to January 29, 2021.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-042 Low-Cost High-Reliability Thermoelectrics for Waste Heat Conversion	Applied Research and Development	This project is developing a cost-effective mid- to high-temperature range (400-800C) p-type thermoelectric material for waste heat recovery using silicon nanowire arrays. The intent is to surpass technologies implementing an organic Rankine cycle or similar processes by having low parasitic losses, compact structure, and ability to be modularized for a broad scale of distributed applications. To achieve the goal, the project will advance the state of the art in nanowire characterization; demonstrate an optimized process for the production of Si nanowire arrays and a process to produce a freestanding array of aligned nanowires; characterize the thermoelectric and mechanical properties of these arrays and single Si nanowire; optimize the fabrication of the Si nanowire arrays; and integrate these arrays into devices capable of heat-to-power conversion. The results of device performance will be used to evaluate the techno-economic impacts of this technology. Taken together, the project will move silicon nanowire technology's Technology Readiness Level (TRL) from 2 to a prototype technology demonstration in a relevant environment (TRL of 5).	4/12/2017	No	Generation	$2,000,000	$2,000,000	$1,062,500	N/A	$1,062,500	$440,167	$0	The Board of Trustees of the Leland Stanford Junior University	$516,502	20.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-043 Cost-Effective and Climate Resilient In-Conduit Hydropower and Civil Works Innovation	Applied Research and Development	This project aims to scale in-canal hydropower retrofits by lowering project footprint and civil works costs. As most drop structures in irrigation canals have a consistent design, the goal is to design and implement a modular powerhouse and standard plant design that can be replicated across irrigation drops in California. Using a simple and more easily scalable design will support the installation of the system across the low-head sites identified across California with in-canal potential.	4/12/2017	No	Generation	$954,715	$954,715	$96,816	N/A	$96,816	$0	$3,430,000	Natel Energy	$954,715	50.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-044 Hyper Efficient Pump Motor Unit with Fully Integrated Permanent Magnet Motor and Motor Controls with Combined Liquid Cooling	Applied Research and Development	This project is developing an economical and efficient configuration for large scale integration and adoption of highly efficient liquid cooled permanent magnet motors, and fully integrated, liquid cooled motor controls. The goal is to use these technologies in the development of a smart pump motor unit that can quickly be commercialized and adopted statewide.	4/12/2017	No	Demand-side Management	$2,311,050	$2,311,050	$2,056,775	N/A	$2,056,775	$99,350	$0	Terzo Power Systems, LLC.; Ansync Labs, Inc.	$145,689	5.9%	Grant

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EPC-16-042 Low-Cost High-Reliability Thermoelectrics for Waste Heat Conversion	Pre-existing intellectual property identified in agreement EPC-16-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will address principal barriers to the widespread application of current thermoelectric materials by providing a low-cost, reliable, affordable, and mass-producible technology that can be broadly applied to convert high-temperature heat that is currently wasted at the production and retail levels in California.	1h, 3h, 4a	LBNL made a subcontractor change, with Stanford University now responsible for manufacturing the thermoelectric nanofibers. An amendment to add Stanford as a major subcontractor and extend the project term to recover lost time was approved and research is currently underway. To date, individual Si nanowires have been produced and the thermal properties have been measured.
EPC-16-043 Cost-Effective and Climate Resilient In-Conduit Hydropower and Civil Works Innovation	Pre-existing intellectual property identified in agreement EPC-16-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 32 bidders	Natel Energy	Group 1: Ranked # 3	N/A	N/A	No	Greater reliability will be achieved by enabling greater penetration at significant total megawatts of new, distributed baseload renewable energy with predictable generation profiles. The project will also significantly reduce the capital cost of installing small hydropower in existing irrigation drop structures by reducing the cost of construction and civil works by an estimated 50 percent when compared with installing custom designed works and equipment for each site.	1a, 1b	The project kicked-off in July 2017. The project team selected two sites for demonstration: Alder Drop in Yolo County, and Murphys Afterbay in Calaveras County. Interconnection applications for both projects were filed with PG&E. CEC staff was informed in early July, 2019 that the economics of the project as currently structured are not viable, hence the project was placed under a stop work order. The project was placed under a stop work order while exploring options to deploy at an alternate site.
EPC-16-044 Hyper Efficient Pump Motor Unit with Fully Integrated Permanent Magnet Motor and Motor Controls with Combined Liquid Cooling	Pre-existing intellectual property identified in agreement EPC-16-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Terzo Power Systems, LLC.	Phase 1 Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project could reduce the operating cost for hydraulic power systems by integrating an efficient permanent magnet motor, efficient motor controller, and a combined liquid cooling loop. Hydraulic power systems are found in nearly all industrial facilities.	1f, 1h	The recipient has completed reports on the Insulated-Gate Bipolar Transistor (IGBT) and Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) efficiency. Other tasks completed include testing with the hydraulic manifold and finalized machining work for aluminum housing for eventual thermal, hydraulic and electrical testing.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-045 Development of New Technologies for Agricultural Loads to Participate in Renewables Integration, RTP Programs, and/or New Time of Use Rates	Applied Research and Development	This project develops a smart irrigation control system that improves and expands on current remote irrigation pump switching technology. The technologies developed will provide growers with the ability to automate their preferred load control strategies in response to new time-of-use electricity rates. Beyond that basic capability, the systems facilitate automated response to utility and system operator demand response signals, enabling participation in current and future demand response and reliability programs. The system is being deployed and tested on multiple farms and multiple crop types in PG&E service territory in the Fresno area.	4/12/2017	No	Grid Operations/ Market Design	$2,884,912	$2,884,912	$2,073,453	N/A	$2,073,453	$415,408	$0	Polaris Energy Services Inc.	$649,485	18.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-046 Pilot Testing of Isothermal Compression	Applied Research and Development	Gas Technology Institute (GTI) and Carnot Compression LLC (Carnot) are developing and field testing a novel, near isothermal air compressor which will enable improved efficiency, maintenance and reliability. The unit will be tested at an industrial facility in southern California. This project hopes to reduce the energy consumption in industrial, water, agricultural, and commercial applications that require compression of air and other gases. This project demonstrates a more efficient compressor that will use less electricity to meet the same performance metrics of existing air and gas compressors. If successful, this project could improve the energy efficiency of compressed air/gas systems which are prevalent in all industrial processing facilities.	4/12/2017	No	Demand-side Management	$2,570,946	$2,570,946	$1,861,364	N/A	$1,861,364	$628,022	$0	Carnot Compression LLC	$238,700	8.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-047 California Biopower Impact Project	Applied Research and Development	This project develops an attributional life cycle assessment framework for various biomass-to-electricity supply chain and end-use scenarios that are specific to California. The research effort quantifies on a fine geospatial scale the amount of technically recoverable forest and agricultural biomass residue material in California, and it considers future impact projections from different climate change scenarios and fire risk probabilities under various harvest and land management scenarios. Based on the estimates, researchers are developing a detailed life cycle inventory - disaggregated by parcel, supply chain, and end-use characteristics. Results will support development of the California Residual Biomass-to-energy Carbon Accounting Tool (C-BREC) that will be made available to public and could inform policy decisions on the role of biomass residues in California's energy portfolio.	4/12/2017	No	Generation	$1,000,000	$1,000,000	$559,284	N/A	$559,284	$247,784	$0	Humboldt State University Sponsored Programs Foundation; Sierra Institute for Community and Environment	$131,575	11.6%	Grant

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EPC-16-045 Development of New Technologies for Agricultural Loads to Participate in Renewables Integration, RTP Programs, and/or New Time of Use Rates	Pre-existing intellectual property identified in agreement EPC-16-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Polaris Energy Services Inc.	Phase 1 Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	For many electrical utilities, agriculture is a significant component of their peak load. Collectively there are between 160,000 and 170,000 irrigation pumps in the Central Valley. This project addresses the direct electricity cost of irrigation for agricultural customers and the indirect cost to all electricity ratepayers of procuring sufficient resources to meet marginal peak demand, integrating variable renewable energy generation, and building sufficient infrastructure to support agricultural pumping load peaks. The project goal is to develop control systems and operational strategies that can adapt to different rate designs--including dynamic and DR-program tariffs--by optimizing pumping loads across large numbers of irrigation pumps to me	1c, 1d, 1e, 1g, 1h, 3f	Progress this year includes completing hardware, software, and program development and deployment to start the transactive energy pilot, and analyzing initial results. Preliminary results indicate the ability of pilot test sites to effectively shift irrigation pumping loads (about 30 percent can be successfully shifted). The team has also engaged regulators, utilities, and industry to increase awareness of obstacles that prevent the agricultural sector from participating in demand flexibility markets and programs.
EPC-16-046 Pilot Testing of Isothermal Compression	Pre-existing intellectual property identified in agreement EPC-16-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Institute of Gas Technology dba Gas Technology Institute	Phase 1 Group 1: Ranked # 4	N/A	N/A	No	This near isothermal compressor, or Carnot Compressor, solves the heat of compression problem by using a working liquid to compress a gas, while actively removing the heat of compression throughout the compression process. By removing the heat throughout the compression step, the energy required to compress air from near atmospheric pressure to ~100 psig can be reduced by up to 50% compared to commercial air compressors, such as piston, screw, and scroll designs. These energy savings are expected to significantly improve the efficiency of industrial air applications.	1f, 1h	The project team has validated all mechanical functioning and controls system operations and have continued tuning the system and making preparations for delivery to GTI's Davis facility. GTI anticipates delivery of the prototype system to Davis in March.
EPC-16-047 California Biopower Impact Project	Pre-existing intellectual property identified in agreement EPC-16-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Humboldt State University Sponsored Programs Foundation	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This research project develops a rigorous California-specific lifecycle emissions accounting framework for evaluation of various forest biomass residue mobilization scenarios, quantification of key potential environmental and climate impacts associated with biomass residue mobilization and conversion to electricity, and identification of potential pathways for offsetting biomass residue mobilization costs. The framework and Carbon Accounting Tool (CaRBCAT) will provide California policymakers with an evidence-based, spatially-disaggregated, and probabilistic analysis to aid in creating policies aimed at managing the environmental performance of bioenergy systems. Ultimately, the results from this project will provide information on the topic of carbon neutrality of residual biomass-to-energy production.	2a, 3a, 3g, 4a, 4b	The research team has conducted a net potential recoverable forest and agricultural residue assessment and compiled a spatially explicit database of these materials. The team has also developed a residual biomass-to-energy life cycle emissions accounting framework that considers various supply-chain and end-use scenarios for California and published a beta version of an interactive accounting tool for GHG and criteria pollutants emissions accounting from woody biomass converted to electricity in 2019. Additionally, the research team continued working on the wildfire risk impact assessment, nearly completed characterization of secondary environmental and climate impacts from woody biomass, and started development of a document with policy considerations.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-048 Development and Testing of an Energy Efficient Ultra-low Charge Ammonia Refrigeration System in a Food Processing Plant	Applied Research and Development	This project is pilot testing and demonstrating an air-cooled, low-charge ammonia refrigerant-based, integrated package closed cooling system for an industrial food processing application. The project is demonstrating the effectiveness of a water-saving innovation with the use of a micro-channel, air-cooled condenser. The project is demonstrating the expected energy savings of 20% compared to a chiller using hydrofluorocarbon (HFC) refrigerant for similar end use at the same site. This system eliminates the need for water for cooling. The entire system can be prepackaged and factory charged, and brought to site as an integrated package which simplifies field installation and makes it cost effective.	4/12/2017	No	Demand-side Management	$2,406,054	$2,406,054	$685,220	N/A	$685,220	$804,238	$0	Electric Power Research Institute, Inc.; TAKARA SAKE USA	$605,000	20.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-049 Ultra-High Power Density Roadway Piezoelectric Energy Harvesting System	Applied Research and Development	This project leverages a multidisciplinary system approach to investigate the energy recovery potential of dual-mode piezoelectric generators to create roadway piezoelectric energy harvesting systems with ultra-high power density and efficiency. The goal is to design and test a piezoelectric roadway energy harvesting system, consisting of multi-layer stack generators and power electronics, to capture over 50% of the compression mechanical energy as electricity from passing vehicles. This project will demonstrate electric power generation, in the laboratory and on a 95 feet x 12 feet section of a road at the UC Merced campus, and will determine feasibility for future large-scale demonstrations on highways and streets with piezoelectric under-pavement.	4/12/2017	No	Generation	$1,270,000	$1,270,000	$125,133	N/A	$125,133	$310,100	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-050 Scaling Reliable, Next-Generation Perovskite Solar Cell Modules	Applied Research and Development	Recent advances have pushed the solar conversion efficiency, making perovskites one of the most efficient solar technologies in existence. This project will use a scalable large-area manufacturing approach for fabrication of the perovskite solar absorber, the solar cell's transport and contact layers, and the encapsulation of the solar cell modules. The project will also include bifacial module design, where light enters from both front and back.	4/12/2017	No	Generation	$1,450,000	$1,450,000	$896,217	N/A	$896,217	$184,540	$550,000	The Regents of the University of California, San Diego	$146,050	9.2%	Grant

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EPC-16-048 Development and Testing of an Energy Efficient Ultra-low Charge Ammonia Refrigeration System in a Food Processing Plant	Pre-existing intellectual property identified in agreement EPC-16-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	Electric Power Research Institute, Inc.	Phase 1 Group 1: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	An air cooled, low-charge, ammonia refrigerant based integrated closed-packaged system with semi-hermetic motor/compressor seal that eliminates the mechanical seal between the compressor and the motor is not available in the U.S market today. As this is a packaged product, the M&V data from this project will help verify the energy savings and benefits and make it easier for customers to understand and implement this new technology and reap the energy and water savings benefits from it.	1e, 1f, 1h, 2a	The recipient has completed the low-charge, packaged ammonia chiller installation and is operating normally as confirmed by monitoring and verification (M&V) data. Preliminary M&V results show that the ammonia chiller is 38 % more efficient than the R-507A chiller. The Coefficient of Performance of the ammonia chiller is 4.87. The recipient is drafting the Technology Transfer Plan
EPC-16-049 Ultra-High Power Density Roadway Piezoelectric Energy Harvesting System	Pre-existing intellectual property identified in agreement EPC-16-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	University of California - Merced	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project advances a piezoelectric energy harvesting system with ultra-high density and efficiency. Using an award-winning piezoelectric technology with unique dual-mode and multi-layer generator design and under-pavement installation strategy for smooth drive of passing vehicles and pedestrians, this project will help the ratepayers in California by reducing cost of electricity and reducing emissions related to power generation.	1e, 3h, 4a	The project has completed design and fabrication of a batch of multi-layer piezoelectric generators and metal frame, and has conducted laboratory evaluation of the prototype. The prototype design was revised and improved, resulting in a promising relationship between the loading and displacement of the piezoelectric unit. An order to purchase 200 piezoelectric generator towers was issued and the project team has fabricated mechanical parts for 100 piezoelectric generators. A patent has been filed for the mechanical amplification design.
EPC-16-050 Scaling Reliable, Next-Generation Perovskite Solar Cell Modules	Pre-existing intellectual property identified in agreement EPC-16-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	The Regents of the University of California, San Diego	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Currently, encapsulated perovskite cells degrade in several hundred hours even in controlled low-oxygen and low-humidity conditions. This project integrates materials innovations developed to date at UC San Diego in the perovskite absorber layer, the solar cell's contact layers, and the encapsulation of the module to make breakthrough advances in perovskite solar cell reliability and scaling. Combining these materials together in a module assembly with glass on top and bottom slows degradation by a factor of 1,000. In addition, the bifacial design of the module boosts its efficiency.	2a, 4a	The project team successfully transferred graphene atop perovskite layers, developed new electron transport layers, and is improving cell process by characterization and new absorber layer chemistry. The project team is now comparing the unencapsulated perovskite against the graphene barrier layer encapsulated perovskite cells. The project is growing crystals by using an electro-deposition approach. The project has established an 80% yield on perovskite solar cells of 5 mm2 in size of at least 16% power conversion efficiency under one sun.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-051 Increased Energy Efficiency via Programmable Irrigation and Fertigation	Applied Research and Development	PowWow Energy, in collaboration with WiseConn Engineering, West Hills College Coalinga (WHCC) and UC Santa Barbara (UCSB), is developing an automated, programmable irrigation management system that integrates cutting-edge technologies to increase the energy efficiency of irrigation (defined as using less energy to achieve the same level of crop production). Pilot-scale tests of the integrated technology platform will be conducted at two sites on commercial farms located in disadvantaged communities: an almond orchard near Delano (AgWise Enterprises, SCE territory) and a field with a rotation of row crops (tomato, garlic, etc.) near Huron (Woolf Farming and Processing, PG&E territory).	4/12/2017	No	Demand-side Management	$2,992,660	$2,992,660	$1,769,894	N/A	$1,769,894	$341,285	$0	Environmental Studies Program & Bren School of Environmental Science & Management - UC Santa Barbara; PowWow Energy, Inc.; Aduro Accounting & Consulting, LLC; TBD Professional Services; WiseConn Engineering; West Hills College Coalinga; Mamala Research, LLC	$350,547	10.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-052 Force Multiplier Actuated Piezoelectric Energy Harvester for Roadway Energy Recovery	Applied Research and Development	The project develops, designs, and installs a multitude of pavement-embedded devices to demonstrate energy harvesting from overpassing motor vehicles on the road in smart pavement covering 36 feet x 6 feet. The system consists of materials that exhibit the piezoelectric effect, generating an electric charge.	4/12/2017	No	Generation	$1,000,000	$1,000,000	$582,507	N/A	$582,507	$234,596	$0	Pyro-E, LLC	$100,007	9.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-053 Habitat Influences on Desert Tortoise Translocation Success	Applied Research and Development	The project team is determining if habitat characteristics of the release sites can improve survival rates of smaller juveniles to the point that they are equivalent to the rates of the animals that were released only after reaching the desired size target. Careful measurement of resources that may help tortoises avoid predation or meet nutritional requirements will allow investigators to differentiate excellent habitat from merely adequate habitat. They are also studying the effects of outdoor rearing on juvenile desert tortoise behavior and health, and size-age relationships to survival in the wild upon their release. The project will generate quantitative scientific information about the most cost-effective husbandry and release methods during and following a head-start program for this threatened species.	4/27/2017	No	Generation	$499,605	$499,605	$302,441	N/A	$302,441	$32,237	$0	Zoological Society of San Diego dba San Diego Zoo Global	$390,528	43.9%	Grant

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EPC-16-051 Increased Energy Efficiency via Programmable Irrigation and Fertigation	Pre-existing intellectual property identified in agreement EPC-16-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 27 out of 28 bidders	PowWow Energy, Inc.	Phase 1 Group 1: Ranked # 1	N/A	N/A	Yes; Small Business, Calif Based Entity	This project integrates three new strategies for water and energy efficiency on farms (continuous pump testing with automated remote pump control, programmable irrigation for specific soil types and plant varieties, and management of water and fertility) with PowWow's software. If successful, this project could help individual farms realize energy, water and cost savings without affecting crop yield or quality.	1h, 4a, 4c	Project team is working towards completing of Task 3 - which is the development of the soft for the programmable irrigation and fertigation so that work can begin on Task 4 which will be the integration of the software onto the mobile app to allow workers in the field to control pump system and implement precision irrigation and fertigation techniques.
EPC-16-052 Force Multiplier Actuated Piezoelectric Energy Harvester for Roadway Energy Recovery	Pre-existing intellectual property identified in agreement EPC-16-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 20 out of 20 bidders; phase 2: 9 out of 9 bidders	Pyro-E, LLC	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project demonstrates and assesses the potential of regenerative pavement technology, a roadway-embedded energy harvester that uses the untapped energy of car movements. The hardware devices developed using smart materials harvest energy from pavement deflections and vibrations under normal driving conditions. Energy performance data is collected to determine the technology's potential for widescale adoption in roadways and other surfaces.	1e, 2a	The project team completed basic design for the vibrational energy harvester, with a goal to maximize life under repeated impact and compression cycles from a vehicle. A batch of flexors, for converting vertical compression into horizontal extension, was fabricated and calibrated with force transducers and strain instruments to ensure proper specifications. A uniform subscale piezo-ceramic stack prototype was fabricated and assembled to prevent stress concentrations under buckling loads. Preliminary field testing at subscale was performed to collect data for power and energy. Work has started for permitting with the City of San Jose.
EPC-16-053 Habitat Influences on Desert Tortoise Translocation Success	Pre-existing intellectual property identified in agreement EPC-16-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	Zoological Society of San Diego dba San Diego Zoo Global	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will increase the effectiveness of conservation actions designed to mitigate renewable energy impacts on Mojave Desert tortoises. This will be achieved by evaluating the relative effectiveness of head-start and release methods in an experimental framework. Improvements to the effectiveness of habitat management to encourage natural recruitment of juveniles will also be tested experimentally where possible.	2a, 3a, 3b, 4f	The project completed hatching of the first cohort of 63 hatchling tortoises at Edwards Air Force Base (EAFB). This number should be sufficient for the 18-month old group to be released in 2020. Unfortunately, there was complete nest failure at the Cadiz site. With the advice and consent of the Technical Advisory Committee, researchers developed a plan to overcome this setback by attempting to collect a larger number of eggs in 2019 so that half could be reared indoors to reach the size the 18-month cohort would have achieved. However, they were unable to collect a sufficient number of eggs. Investigating the cause of the nest failure should lead to improved guidance for head-starting. Analysis will still allow evaluation of release habitat, but age/size class comparisons will only be available for EAFB tortoises. The team is collaborating with a complementary project (EPC-16-038).

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-054 Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services	Applied Research and Development	This project develops a "3-in-1" smart inverter, charging station, and building management system. The project focuses on defining and developing control algorithms to implement vehicle-to-grid (V2G) and vehicle-to-building (V2B) with minimal impact to the plug-in electric vehicle (PEV) battery life. This project develops and demonstrates the Smart Power Integrated Node (SPIN) device -- an off-vehicle V2G power conversion and control device that can be applied to residential and small commercial applications. The system integrates a bidirectional direct-current (DC) PEV charger, photovoltaic inverter, and stationary storage battery, with an integrated local energy and power management system for power and energy management, grid communications, and ancillary services.	4/27/2017	No	Demand-side Management	$1,500,000	$1,500,000	$1,286,987	N/A	$1,286,987	$523,706	$0	Electric Power Research Institute, Inc.; Oak Ridge National Laboratory; National Renewable Energy Laboratory (NREL); Flex Power Control, Inc.	$2,341,001	60.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-055 Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers	Applied Research and Development	The project enables day-ahead and real-time pricing for DC fast charging by developing an integrated hardware and software platform to reduce demand charges from DC fast charging and address intermittency and renewable energy over-generation issues. The site controller and network-based platform advances smart and efficient charging by managing four multi-port fast charging stations to minimize grid impact and lower the cost of operating fast chargers, evaluates the suitability of DC fast charging to participate in demand response programs, and develops and evaluates advanced technologies to efficiently integrate second-life PEV batteries for demand management with DC fast charging. By addressing intermittency and renewable energy over-generation issues, the project will reduce grid impact and increase renewable penetration in the grid by aggregating four DC fast charging stations with stationary battery storage from second-life PEV batteries.	4/27/2017	No	Demand-side Management	$826,250	$826,250	$498,963	N/A	$498,963	$0	$0	Zeco Systems dba Greenlots	$302,008	26.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-056 Performance Evolution, Specification and Verification of Building Control Sequences	Applied Research and Development	The DOE co-funded agreement develops software tools that can be integrated with OpenStudio, which is an open-source software that supports large-scale analysis, including design optimization, model input calibration, building stock analysis, and analysis to develop typical savings values. The project goal is to develop an integrated set of software tools to enable design engineers to use energy-efficient ASHRAE-developed software for commercial buildings. The project is expected to reduce the time to specify, implement and verify the proper operation of building control sequences. The design tool could enable more efficient building operations and reduce operating costs.	5/10/2017	No	Demand-side Management	$1,000,000	$1,000,000	$910,349	N/A	$910,349	$473,633	$3,065,000	None	$0	0.0%	Grant

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EPC-16-054 Open Vehicle to Building/Microgrid Integration Enabling ZNE and Improved Distribution Grid Services	Pre-existing intellectual property identified in agreement EPC-16-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will determine the strategies and methodologies for V2G to become a value-added distributed energy resource (DER) asset to reduce ratepayer peak demand and defer grid upgrade costs. Results will inform investor-owned utilities on how V2G and V2B can be a viable resource to meet the Assembly Bill 2514 Storage Mandate and the CAISO energy storage and distributed energy resource initiative. The project will enable validation and valuation of the most effective use cases and intelligently aggregate distributed energy resources to enable and accelerate V2G and V2B charging and discharging strategy adoption to alleviate constrained distribution system nodes.	1c, 1e, 2a, 3f, 4a, 5b	The project team has developed and documented the control algorithms to aggregate and balance the vehicle charging, building loads, energy storage, and renewable energy generation. The team has also conducted integration and testing of the SPIN functionalities. Further refinement of the SPIN master communication controller and EVSE communication module is near completion.
EPC-16-055 Improving Commercial Viability of Fast Charging by Providing Renewable Integration and Grid Services with Integrated Multiple DC Fast Chargers	Pre-existing intellectual property identified in agreement EPC-16-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Zeco Systems dba Greenlots	Group 1: Ranked # 1	N/A	N/A	No	This project is advancing the aggregation of DC fast chargers to optimize vehicle charging from either the grid or the stationary battery storage based on the day-ahead and real-time pricing data from the electric utility to reduce grid congestion and mitigate renewable energy over-generation. This optimization will lower the cost of EV charging, directly translating into cheaper PEV charging for the ratepayers and increase PEV penetration.	1e, 1h, 2a, 4a	The project team has completed development, testing, and integration of the demand response functionality into Greenlot's SKY (cloud) platform. Greenlots has completed building the base platform and algorithms to support the hardware integration. Smart charging algorithm performance testing and optimization on multiple level 2 PEV chargers in the lab has been completed. Greenlots is preparing their demonstration site for EVSE and battery storage, which will be commissioned by the end of 2019. Field testing and data collection will begin immediately after the site is commissioned.
EPC-16-056 Performance Evolution, Specification and Verification of Building Control Sequences	Pre-existing intellectual property identified in agreement EPC-16-056 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Lawrence Berkeley National Laboratory	N/A ****	N/A	N/A	Yes; Calif Based Entity	This federal cost share grant with the US Department of Energy, will develop open source tools to enable verification of building control strategies and will integrate building controls, lighting and HVAC with the smart grid to provide fast and slow demand response. The breakthrough will be that designers can use pre-tested ASHRAE building control sequences or custom sequences, adapt and optimize, and test their impact on energy, peak power reduction, indoor air quality and thermal and visual comfort. The control sequences can be exported to the control vendor to obtain cost estimates and can be used by commissioning agents to verify that the original design intent is realized. This will enable accountability for controls performance between design and operation and is expected to have broad adoption and impact.	1f, 3a, 3b, 3f, 4a	The team reviewed the control sequences for primary systems based on a new version of ASHRAE that was released in July, 2019. Due to the complexity of the task due to the updates, there have been some delays. The team expectx to finalize the first version of these tests by the next quarter. The modeling for the case study remains on hold until the testing is completed because these sequences are required for the case study. A quarterly review meeting is scheduled with DOE in January. The team will complete the modeling case studies for the primary HVAC system. The commercialization and market transformation plan was submitted. The next milestone will be to complete writing the code that will allow editing and composing, the control blocks will be represented in a pictorial form.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-057 Development of Smart Charging Infrastructure Planning Tool (SCRIPT)	Applied Research and Development	This project is developing the Smart Charging Infrastructure Planning Tool (SCRIPT) that will produce spatial-temporal forecasts of electric vehicle (EV) charging demand and flexibility. The SCRIPT tool is being tested to determine daily predictive smart charging strategies that will anticipate future travel needs of drivers and grid conditions. SLAC is studying the role of different charging infrastructure investment strategies in the effectiveness of EV smart charging techniques to accommodate state level renewable penetration goals in California. SLAC is testing the tool using real-time charging data to determine the maximum amount of solar generation that can be absorbed by the vehicles through smart charging. SLAC is also studying the tradeoffs between investing in new charging infrastructure compared to better management of existing infrastructure via smart charging.	5/10/2017	No	Demand-side Management	$1,500,000	$1,500,000	$1,391,076	N/A	$1,391,076	$328,945	$0	UC Santa Barbara; ChargePoint, Inc.	$94,193	5.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-058 Advanced Transit Bus VGI Project	Technology Demonstration and Deployment	This project addresses critical real-world needs to commercialize and scale electric transit fleets with robust grid-serving energy services. Leveraging Santa Clara Valley Transit Authority's (VTA) plan to purchase up to 35 all-electric buses to electrify its 500-bus fleet, the project team will demonstrate strategies to improve the business case of e-buses, including reducing cost via advanced management, establishing revenue generation opportunities, addressing commercial fleet management needs, and ensuring benefits reach all communities by delivering e-bus transit to underserved communities.	5/10/2017	No	Demand-side Management	$1,899,199	$1,899,199	$951,651	N/A	$951,651	$412,909	$0	Santa Clara Valley Transit Authority; Proterra Inc.	$1,035,018	35.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-059 Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Service and Renewable Power Penetration	Applied Research and Development	This project demonstrates an automated control system for a fleet of PEVs and repurposed second-life batteries that reduces the overall cost of ownership by maximizing battery lifetime, shifting load to minimize electricity and demand charges, and providing V2G and V2B services, including those supporting the use of onsite solar generation. The demonstration adds a stationary second-life battery installation to the existing PEV fleet site at the Los Angeles Air Force Base.	5/10/2017	No	Demand-side Management	$1,500,000	$1,500,000	$981,533	N/A	$981,533	$407,071	$0	None	$0	0.0%	Grant

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EPC-16-057 Development of Smart Charging Infrastructure Planning Tool (SCRIPT)	Pre-existing intellectual property identified in agreement EPC-16-057 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	There are significant benefits from workplace smart charging that may be shared with the vehicle owners. By exercising the flexibility of the vehicle charging in the workplace, commercial customers can save from energy and demand charge costs. Smart charging can decrease energy charges by up to 1.5% of the overall utility bill, and decrease demand charges by up to 24.7%. Further benefits can be achieved from adding PV as a distributed energy resource at a site, but even without that addition there are significant benefits to both the EV owner and workplace where the EV is being charged. The project team is conducting a cost-benefit analysis that will inform the final report.	1e, 1f, 3a, 3f, 4a, 5b	The Smart Charging Infrastructure Planning Tool (SCRIPT) continues to be developed. The preprocessing and data upload has been completed, and the next key tasks will focus on completing the user interface for SCRIPT. The remainder of the project term will complete development of the SCIPT tool and support iterations based on Technical Advisory Committee feedback. SLAC will continue with analysis and improvements and finalize implementation of the cost-benefit analysis in the tool.
EPC-16-058 Advanced Transit Bus VGI Project	Pre-existing intellectual property identified in agreement EPC-16-058 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Prospect Silicon Valley	Group 4: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The project will make the following advances by: 1) translating automotive VGI advancements to a commercial e-bus fleet, including retail and wholesale energy services; 2) delivering advanced optimization of battery life and cyber security; 3) integrating energy services and management with leading commercial fleet management tools; and 4) integrating key Energy Commission funded VGI platforms and providing a roadmap for statewide deployment.	2a, 4a, 4b	In 2019, the project team was focused on developing the Energy Management Platform (EMP), which serves the smart charging needs of the electric bus fleet and will be used to determine best practices for wide scale adoption. The development of the EMP was a coordinated effort amongst many subcontractors. Communication systems were implemented at VTA facilities as well as on the electric buses to develop seamless communications between the electric buses and the EMP at VTA. Bus state-of-charge range, efficiency, odometer readings, and MAC ID settings between the actual busses and the EMP were successfully tested for full integration at VTA.
EPC-16-059 Advanced VGI Control to Maximize Battery Life and Use of Second-Life Batteries to Increase Grid Service and Renewable Power Penetration	Pre-existing intellectual property identified in agreement EPC-16-059 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Lawrence Berkeley National Laboratory	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project is developing and implementing an optimization and control algorithm for a fleet of PEVs and stationary battery packs that includes impacts on battery health expressed as an economic cost, using models and parameters derived from actual battery measurements. These activities will help demonstrate PEV ownership lifecycle cost reductions and will advance scientific knowledge of the impacts of V2G and V2B services on mobile and second-life PEV batteries.	1h, 3f, 4b	The project team upgraded the existing 13 Princeton Power Systems (PPS) charging stations with new computers and the latest software at the time to provide V2B capabilities. In April 2019, four out of the 12 Nissan EVs have been upgraded with new battery packs. However, the project team confronted multiple challenges, including communications issues between PPS charging stations and the EVs and the bankruptcy of PPS. These issues have delayed the second-life battery phase of the project.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-061 Intelligent Electric Vehicle Integration (INVENT)	Technology Demonstration and Deployment	This project is deploying vehicle-grid integration (VGI) technology with unidirectional and bidirectional power flow capabilities using light fleet and consumer vehicles. These vehicles will provide local grid support by controlling the charge rate based on locally available energy and power capacity, controlling the voltage, and providing grid-wide support by participating in frequency regulation or adjusting the reactive power. The mix of services provided will be optimized within a campus laboratory setting with the goal of expanding this technology into a real-world setting.	6/14/2017	No	Distribution	$4,200,000	$4,200,000	$1,709,724	N/A	$1,709,724	$212,026	$0	The Regents of the University of California, San Diego; Strategen; Nuvve Corporation; FleetCarma	$3,697,744	46.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-062 Advancing Demand Response in the Water Sector	Applied Research and Development	This project is developing a demand management system to optimize energy use and operations using the Moulton Niguel Water District as a pilot site. By better optimizing its system, the water utility will be able to reduce its energy bill by participating in demand response and load shifting incentive programs. The project will optimize load for the potable and recycled water systems at Moulton Niguel while developing a software platform and management system that can be easily adopted by other water districts and utilities.	5/10/2017	No	Demand-side Management	$2,984,983	$2,984,983	$95,959	N/A	$95,959	$282,171	$0	Moulton Niguel Water District; Helio Energy Solutions	$105,765	3.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-063 Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning	Applied Research and Development	This project develops new and better ways of merging two modeling approaches, using both weather forecast models (more generally called dynamical models) and inferences from past history (statistical models). The combined method is called a hybrid dynamical-statistical approach for inferring fine-resolution climate information from the coarse-resolution global climate models. Ideally, the hybrid approach will be able to capture many of the physical processes simulated by the costly weather forecast models, but with the reduced expense of statistical models. The hybrid approach will be applied to three key areas of California's climate that have important implications for the state's ratepayers: wind, clouds, and hydrology.	4/27/2017	No	Grid Operations/ Market Design	$1,399,888	$1,399,888	$300,471	N/A	$300,471	$192,928	$0	None	$0	0.0%	Grant

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EPC-16-061 Intelligent Electric Vehicle Integration (INVENT)	Pre-existing intellectual property identified in agreement EPC-16-061 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Nuvve Corporation	Group 4: Ranked # 5	N/A	N/A	No	This project is developing an advanced VGI technology to optimize the blend of unidirectional charging, bidirectional operation, and vehicle-to-building functions, for different real-world grid applications such as frequency regulation, power quality, voltage control, and grid support. The project will show the value of EVs as distributed energy resources, with the ability to defer or eliminate the need for grid upgrades, and enable greater renewable energy penetrations.	1h, 3f, 4b	In 2019, Nuvve successfully demonstrated and operated nine uni-directional and nine bi-directional charging stations on the UCSD campus. These charging stations have demonstrated frequency regulation, demand response, and demand charge management as part of Nuvve's use cases. Also, Nuvve has shown the implementation of uni-directional demand charge management at one of the UCSD parking garages resulting in potential savings to the building in its monthly electric bill. Furthermore, Nuvve announced the participation of Honda Motors of North America in the INVENT project as a project partner by providing three retrofitted, bi-directional Honda Accord PHEVs. These vehicles will participate as part of Nuvve's INVENT project by expanding the existing fleet of bi-directional EVs to demonstrate the use cases mentioned above with a diverse pool of vehicles.
EPC-16-062 Advancing Demand Response in the Water Sector	Pre-existing intellectual property identified in agreement EPC-16-062 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 6 out of 7 bidders	Regents of the University of California, Davis	Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The demand management system uses real-time energy analytics to: (1) reduce and/or shift peak energy loads, (2) account for different energy tariff structures, and (3) balance the grid's intermittent renewable load generation. This demand management tool enables water utility participation in demand response and load shifting utility programs. Along with marketing and communicating the technology, the tool will inform other water utilities, and could result in increased use and acceptance. Given the impact of energy consumption by the water industry in California responsible for 10% of the state's electricity demand, widespread use of the proposed methodology could help achieve energy demand reduction needed to support the state's energy goals.	1e, 1g, 1h, 2a, 3h, 4a	The team has developed an energy grid model and continued to add features to the demand management system (DMS). The team continued to refine data and inputs to the energy demand management system software, including gathering tariff and grid operation characteristics information from the utilities and the California Independent System Operator. The research team has been adding features to the demand management system to optimize energy demands of water systems. A working prototype of the DMS has been developed and is currently being tested at the water utility for final refinements before a full-scale demonstration.
EPC-16-063 Advanced Statistical-Dynamical Downscaling Methods and Products for California Electricity System Climate Planning	Pre-existing intellectual property identified in agreement EPC-16-063 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	University of California, San Diego Scripps Institution of Oceanography 0955	Group 6: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project will include an extensive quantification (model validation) effort, which will be based on data from observed meteorological stations, satellite records of cloudiness compiled by project members, and USGS stream-flow and groundwater observations (for the hydrologic modeling). The method under development could be used for the California's Fifth Climate Change Assessment and future energy planning.	5c	The research team is running dynamic regional climate models and exploring the use of statistical models for hourly simulations. In the past, climate scenarios for California only included projections with daily resolution. The Energy Commission's Energy Forecast Office is moving towards hourly forecasts. The research team has made significant progress on key areas, including development of a training dataset for wind speed and direction at hub height as well as daily precipitation, and some preliminary results will be available early in 2020.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-064 Investigating Avian Attraction to Solar Energy Facilities Through a Lake Effect	Applied Research and Development	Researchers are exploring the behavior of attraction by birds to solar facilities, particularly in relation to the "lake effect" hypothesis. Specifically, they are studying 1) the ability of birds to detect potentially attractive visual cues associated with solar facilities (e.g., polarized light, irradiance); 2) the corresponding change in flight behavior characteristic of movement toward solar facilities; and 3) the mortality and natural history of birds that actually occupy solar facilities. First, the recipient is examining the sensory basis of attraction through field and lab experiments. Second, radar and thermal imaging are used to measure the degree to which birds alter their flight paths to settle at solar facilities. Data on behavior and mortality from multiple solar facilities are gathered to inform a statistical model to determine what characteristics of solar facilities and species' natural history together explain variations in mortality exhibited across sites.	5/10/2017	No	Generation	$499,785	$499,785	$252,200	N/A	$252,200	$200,240	$50,000	United States Geological Survey; Western EcoSystems Technology, Inc.; Humboldt State University Sponsored Programs Foundation; NRG Energy, Inc.; NextEra Energy; Bard College; 8minuteenergy Renewables, LLC; First Solar; Recurrent Energy	$740,251	59.7%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-065 California E-Bus to Grid Integration Project	Technology Demonstration and Deployment	This project focuses on improving the economics of incorporating e-buses in a transit agency fleet. The project team is working with the Antelope Valley Transit Authority (AVTA) to evaluate multiple scenarios, including smart charging, improving vehicular energy efficiency through best driving practices, and using the vehicle batteries for grid services when the E-buses are not being used for their routes. More effective smart charging reduces the frequency and duration of in-route charging, and the fuel economy improvements that come from smart driving result in operational cost savings. By reducing the likelihood that several/all E-buses will be charging at once, the smart charging platform will achieve greater flexibility to mitigate demand charges and provide grid services.	5/10/2017	No	Grid Operations/ Market Design	$3,327,953	$3,327,953	$1,849,760	N/A	$1,849,760	$792,573	$0	Antelope Valley Transit Authority	$3,729,000	52.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-067 Robust Super Insulation at a Competitive Price	Applied Research and Development	Heating and cooling represents the greatest energy consumption in buildings. This project is developing thermal building insulation material with high R-value at a cost commensurate with conventional insulation materials. The product is expected to provide a significant increase in energy savings for existing buildings.	6/14/2017	No	Demand-side Management	$100,000	$100,000	$100,000	N/A	$100,000	$42,679	$1,600,000	None	$0	0.0%	Grant

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EPC-16-064 Investigating Avian Attraction to Solar Energy Facilities Through a Lake Effect	Pre-existing intellectual property identified in agreement EPC-16-064 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	14 out of 14 bidders	US Geological Survey	Group 1: Ranked # 1	N/A	N/A	No	This project is the first systematic study to determine whether birds are attracted to solar energy facilities and if so, to develop an understanding of the sensory basis and proximal response of birds to solar facilities in relation to the "lake effect" attraction phenomenon. Following from that new understanding, the project will identify potentially viable methods for deterring birds from approaching solar facilities and informing future siting decisions in ways that reduce the likelihood of birds encountering solar facilities.	2a, 3a, 4f, 4g	The first and second field seasons of data collection were successfully completed for both radars at the Desert Sunlight Solar Facility, as well as a bird carcass search and bird use surveys at several additional solar photovoltaic facilities across southern and central California. These data are in the process of being analyzed. The experimental tasks to study bird attraction to polarized surfaces are underway.
EPC-16-065 California E-Bus to Grid Integration Project	Pre-existing intellectual property identified in agreement EPC-16-065 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Zero Net Energy (ZNE) Alliance	Group 4: Ranked # 1	N/A	N/A	Yes; Micro Business, Minority Owned	E-Buses have the technical and economic potential to rapidly displace diesel and CNG transit buses given current replacement cycles. Buses are being deployed with onboard telematics to understand the vehicle's operating health and parameters, and high-power wireless inductive charging is now a viable solution for in-route charging. Together, these technologies help overcome range limitations and uncertainty. However, while these technologies alone provide great value and overcome key adoption barriers, integrating them with analytics and distributed energy resource (DER) management platforms will unlock even greater value.	2a, 3f, 4a	The team has installed six wireless opportunity chargers on two different bus routes. These chargers are used to increase the maximum range of the E-Buses. The team has developed an E-Fleet Energy Model that accounts for the effects of weather, geography, drivers' skill and other factors on the kWh/mi. efficiency of the E-Buses. Fleet operators are seeing the benefits of driver training in reducing the fleet's overall energy usage. The team has also achieved peak load shaving through scheduled charging and it has studied the potential benefits of VGI-related grid services on a transit fleet scale. An E-Bus Deployment Guide has been prepared for fleet operators throughout the state.
EPC-16-067 Robust Super Insulation at a Competitive Price	Pre-existing intellectual property identified in agreement EPC-16-067 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Lawrence Berkeley National Laboratory	N/A ****	N/A	N/A	Yes; Calif Based Entity	Currently, there is no thermal building insulation material that can cost-effectively be assembled with high R-values. This Department of Energy cost share agreement is developing a manufacturing process to achieve a high R-value and decrease the installed thickness of the insulation, at a competitive price. This will make retrofits easier because much less space will be needed to accommodate existing building wall assemblies.	1h	The DOE funded agreement has concluded and the recipient has submitted a draft final report. The team hopes to apply to DOE for future funding to continue work on thermal conductivity. During the course of this project, the team tried various techniques to improve flexibility without compromising the thermal performance. They tested samples for R values to ensure the insulation material performance would not become less stable over time. The observations show that both rigid and flexible insulation samples showed no degradation in the thermal performance after 6 months. They have achieved an R/inch of 9.02 for the one-inch flexible insulation samples however, one of the main challenges is the scale up to create a larger sample size.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-068 Integrated Community-Level Solutions for Resource Management for a Grid and Customer Benefits	Applied Research and Development	This project demonstrates the feasibility of using an integrated community-scale solar plus storage system, sited at a low income multi-family disadvantaged community in Willowbrook, CA. The technology solution balances a combination of grid-connected distributed energy resources (DERs), including advanced solar PV, energy storage, smart inverter, and load management. The project team is working with Southern California Edison to study the distribution grid impacts that the DERs can mitigate, realizing cost savings and enabling increased PV penetration. It is also investigating innovative business strategies to maximize the value of DERs to both end-users and the utility. Another objective of the project is to demonstrate a cost-effective solution to achieving Zero Net Energy (ZNE) within an affordable housing community to realize California's 2020 goal for new sustainable and scalable ZNE communities.	6/14/2017	No	Demand-side Management	$2,976,991	$2,976,991	$357,203	N/A	$357,203	$864,761	$0	Electric Power Research Institute, Inc.; LINC Housing Corporation; Gridscape Solutions, Inc.; OhmConnect, Inc.; Chai Energy; Nextek	$1,002,900	25.2%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-070 Integrating Front-of-the-Meter Energy Storage with Smart PV Inverters and Solar Forecasting	Technology Demonstration and Deployment	The purpose of this agreement is to design and install in front-of-meter energy storage with smart PV inverters and solar forecasting. The research will demonstrate a cost-effective and scalable solution that integrates distributed energy resources to address grid needs and identify cost reductions and revenue-generating opportunities for developers and commercial customers.	6/14/2017	No	Demand-side Management	$1,832,770	$1,832,770	$311,168	N/A	$311,168	$644,129	$0	Electric Power Research Institute, Inc.; Craig Wooster Engineering	$591,438	24.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-073 Valencia Gardens Energy Storage	Technology Demonstration and Deployment	The purpose of this project is to utilize energy storage in front of the meter to increase the ability of the distribution grid to support more local solar while improving overall grid operations and economics. This project will provide a replicable model for California by demonstrating multiple uses: interoperability with normal grid operations, including participation in existing wholesale market opportunities, and enhanced interconnection hosting capacity to accommodate far more local solar; and indefinite solar-driven backup power for prioritized loads. Additionally, this project will recommend advancements in policy, interconnection processes, and market mechanisms that maximize and recognize the full value of local energy storage deployments that are interconnected in front of the meter.	6/14/2017	No	Demand-side Management	$1,994,687	$1,994,687	$797,687	N/A	$797,687	$251,310	$0	PATHION, INC	$620,470	23.7%	Grant

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EPC-16-068 Integrated Community-Level Solutions for Resource Management for a Grid and Customer Benefits	Pre-existing intellectual property identified in agreement EPC-16-068 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project includes high efficiency bifacial 355 W solar modules manufactured by Canadian Solar that can substantially assist commercial and multifamily buildings with roof area constraints, as well as the integration of solar and storage with smart inverters that include segmentation of storage for meeting multiple needs. The project also demonstrates a platform that can manage both loads and storage while integrating DC mini grids to eliminate conversion losses for solar PV.	1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a, 3f, 4a, 4b	The project experienced several issues in the execution of the subcontract agreement between EPRI and LINC Housing, and a significant personnel turnover at LINC Housing that impacted the start of the construction. As a direct result, an amendment was executed in September, 2019, for a 9 month no-cost time extension from June 30, 2020, to March 31, 2021. The construction permit was approved by the County of Los Angeles but experienced a delay. The PV modules were delivered on site in September 2019 but were also delayed due to issues in the procurement process from Canadian Solar, because there was a general shortage supply in the market due to trade tariffs. The interconnection plan has been reviewed and approved by SCE. The construction is anticipated to be completed by December 2019 with data gathering to start immediately thereafter.
EPC-16-070 Integrating Front-of-the-Meter Energy Storage with Smart PV Inverters and Solar Forecasting	Pre-existing intellectual property identified in agreement EPC-16-070 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 6: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project will demonstrate an interoperable solution that integrates in front-of-the-meter energy storage with smart PV inverters and satellite-based solar forecasting to address grid limitations. The idea will enable PV as a grid asset through beneficial integration with storage, capacity management, and communications. To accomplish this, advanced modeling techniques will be used, including EPRI's existing tools for hosting capacity calculation and energy storage value simulation. Advancements that will result from this demonstration will enable aggregated DER control and optimization.	1a, 1e, 3a, 4a	EPRI is in the process of obtaining the interconnection agreement with PG&E. EPRI updated the system design of the in front-of-the-meter energy storage system and resubmitted the interconnection application to PG&E in August 2019. The initial supplemental interconnection report from PG&E was positive. The team expects an executed interconnection agreement with PG&E by December 2019.
EPC-16-073 Valencia Gardens Energy Storage	Pre-existing intellectual property identified in agreement EPC-16-073 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Natural Capitalism Solutions, dba Clean Coalition	Group 6: Ranked # 2	N/A	N/A	No	This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of California's statutory energy goals by utilizing energy storage as a local balancing and optimization solution on a circuit on the distribution grid. The project will demonstrate a combination of advancements and breakthroughs including, but not limited to, an advanced local energy system that utilizes energy storage on a circuit to optimize local circuit balancing, increases PV hosting capacity and provides the California Independent System Operator with ancillary services.	1e, 1h, 4a, 5b	In 2019, the Valencia Gardens project team executed the interconnection agreement with PG&E and has been actively working with PG&E to finalize the construction of the in front of the meter storage system. The project had challenges in scheduling the construction with PG&E, which is essential to complete the installation of the energy storage at the demonstration site. Clean Coalition held working group meetings with PG&E and PATHION to coordinate efforts to expedite the construction and to complete this project successfully. The team is expecting to obtain the permit to operate by Match 15, 2020.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-077 Solar+ Storage Integrated Energy Management Demonstration in a Supportive Housing Facility	Applied Research and Development	The project deploys a 100 kW high-performing solar PV system, a 150 kW/150 kWh li-ion battery energy storage system, a smart inverter, and an advanced energy management platform to demonstrate the advancement of these technologies compared to standard commercially available products. These components will be integrated to optimize flexibility in demand side energy management through load shifting, solar PV self-consumption, emergency back-up, demand response, and ancillary grid services. The proposed system will be able to autonomously meet demand response and energy management requests while critical loads at the building are maintained, minimizing operational impacts. It will also realize energy and demand charge cost savings to the building owner and tenants.	6/14/2017	No	Demand-side Management	$2,110,657	$2,110,657	$220,813	N/A	$220,813	$332,995	$0	LINC Housing Corporation; Regents of the University of California, Riverside Campus; EnSync Energy Systems; EnerBlü	$411,509	16.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-079 Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration	Applied Research and Development	This project will comprehensively evaluate the smart inverter Phase III functions. The process includes computer modeling of California distribution circuits for economic analysis, implementation of Phase III functions in multiple inverter brands, laboratory testing, and field pilot testing. An economic analysis will build on the technical findings from the computer modeling, identifying the impact to the asset owner, performing an economic valuation of these impacts, and providing guidance regarding potential compensation. A comprehensive cyber security assessment of the communication system will be performed and key public infrastructure will be established to support the cyber security needs in California.	6/14/2017	No	Grid Operations/ Market Design	$2,935,822	$2,935,822	$1,353,602	N/A	$1,353,602	$601,394	$0	Electric Power Research Institute, Inc.; SunSpec Alliance; Sunrun	$1,659,077	36.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-001 Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions	Technology Demonstration and Deployment	This project optimizes and simplifies control upgrades (HVAC and lighting) to demonstrate energy savings while also improving occupant comfort by using automated fault detection and diagnostics, continuous commissioning, and advanced measurement and verification procedures. The team will use the results to develop recommendations for strategies, tools, and initiatives to address market barriers and promote large scale market adoption.	7/12/2017	No	Demand-side Management	$2,966,716	$2,966,716	$1,505,533	N/A	$1,505,533	$934,507	$4,600,000	Trane U.S., Inc.; United States Department of Energy; Automated Logic Corporation; Siemens Corporation, Corporate Technology; Kaiser Permanente Medical Center; Enlighted Inc.; Delos; KGS Buildings; Alerton	$2,773,750	48.3%	Grant

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EPC-16-077 Solar+ Storage Integrated Energy Management Demonstration in a Supportive Housing Facility	Pre-existing intellectual property identified in agreement EPC-16-077 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Regents of the University of California, Riverside Campus	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project integrates BESS and PV technology with advanced control algorithms and smart inverter autonomous functions. The solar+ system uses high efficiency solar panels that are DC coupled with Li-ion BESS and demonstrates various smart inverter functions to provide autonomous grid services and energy management practices under a variety of operational conditions. The team is assessing the impact smart inverter-provided grid services and solar + storage operation have on each other. The project provides BESS and PV technology integrated with an energy management system to support diurnal energy loads. This project implements utility-initiated demand response functions and creates an architecture that allows expansion to future power regulation and potential wholesale market participation.	1c, 1d, 1e, 1g, 1h, 2a, 3d, 3f, 3h, 5a	LINC Housing successfully received approved building permits for the Long Beach site in March 2019. As a result, the Energy Commission lifted a Stop Work Order in April, 2019. LINC Housing began site construction in April 2019. UC Riverside submitted the draft Measurement and Verification Plan in September 2019 and the Energy Management System Software Development Report in October 2019.
EPC-16-079 Impact Assessment & Secure Implementation of California Rule 21 Phase 3 Smart Inverter Functions to Support High PV Penetration	Pre-existing intellectual property identified in agreement EPC-16-079 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 4: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will help overcome three major barriers to achieving the state's energy goals by: 1) proving that CA Rule 21 Phase III functions can be deployed feasibly, safely and predictably via standardization; 2) demonstrating that grid penetration levels can be increased by 25% or more via use of the Phase III advanced control functions; and 3) enabling secure, scalable and affordable cyber security infrastructure that can make the grid safer and more reliable.	1a, 1b, 5a, 5b, 5f, 5g	In 2019, the project team continued the evaluation of two commercial smart inverters for Phase III compliance. The lab test at the University of California, San Diego (UCSD) was also leveraged to conduct cyber security testing (penetration testing). The test results were aimed at providing guidelines to California's DER stakeholders about safe and secure deployment of smart inverter communications. A proof of concept for cyber secure communications was established, 50 residential customers were recruited for the field demonstration of Rule 21 Phase III functions, and communication and control systems to update Phase III functions was successfully established.
EPC-17-001 Best-in-Class: Demonstrating Scalable Operational Efficiency through Optimized Controls Sequences and Plug-and-Play Solutions	Pre-existing intellectual property identified in agreement EPC-17-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Taylor Engineering	Group 1: Ranked # 1	N/A	N/A	Yes; Small Business, Calif Based Entity	This project will help achieve the State's energy goals by scaling up the market adoption of control retrofits that result in significant energy savings in commercial buildings. The successful demonstration of scalable, plug-and-play integrated packages of HVAC and lighting controls will allow commercial building owners and operators to maximize energy savings across large portfolios of buildings while reducing transaction costs.	1f, 1h	Progress in 2019 includes completing installations at all demonstration sites, commissioning installed systems, and beginning to collect data. The project team also conducted a critical project review meeting and gathered stakeholder feedback through a second technical advisory meeting.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-002 Scaling Solar+ for Small and Medium Commercial Buildings	Applied Research and Development	This project is developing standardized components for a Solar+ system designed specifically for the SMB sector. The research team is designing, implementing, operating, and evaluating a Solar+ system in a pilot scale application at a convenience store. The project is designed to innovate across three key priority areas necessary for technology scale-up: hardware design guidelines, integration software, and site targeting. Filling these knowledge gaps will help move the deployment of Solar+ technologies forward, thereby bringing substantial benefit to individual building owners, as well as opening opportunities to provide service to the broader distribution and bulk power systems. This project focuses on the convenience store/fueling station SMB sector, but lessons learned and products developed can be transferred to other SMB sectors.	7/12/2017	No	Demand-side Management	$1,500,000	$1,500,000	$871,666	N/A	$871,666	$413,443	$0	Southern California Edison; Humboldt State University Sponsored Programs Foundation; Tesla Motors, Inc.; Serraga Energy, LLC at Blue Lake Rancheria	$345,242	18.7%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-003 Developing a Comprehensive, System-Wide Forecasting to Support High-Penetration Solar	Applied Research and Development	This project is developing, testing, and validating a high-accuracy forecast for photovoltaic (PV) generation across California and coordinating with the California Independent System Operator (CAISO) on incorporating the results into its PV forecasting operation. The comprehensive forecast includes both behind-the-meter (BTM) and in-front-of-the meter scale PV systems. The project is quantifying the costs and benefits of these improvements. The researchers are using mid-term DER adoption forecasts adapted from the investor-owned utility distribution resource plans to project the distribution of DERs through 2050. The team is also providing CAISO with the steps required to incorporate the statistically-adjusted BTM solar PV generation estimates into CAISO's Reconstituted Load approach.	7/12/2017	No	Generation	$750,000	$750,000	$663,876	N/A	$663,876	$261,080	$0	State University of New York at Albany; Clean Power Research, L.L.C.	$320,000	29.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-004 Enhanced Modeling Tools to Maximize Solar + Storage Benefits	Applied Research and Development	This research has developed a solar + storage optimization tool to evaluate the dispatch, operations, and value proposition for integrated solar + storage systems. The tool is capable of evaluating distributed solar with storage and an array of advanced controls and dispatchable DER technologies, and it evaluates optimal dispatch for a wide range of customer programs and incentives. The tool is also designed to integrate into the California Public Utility Commission (CPUC) Distributed Resource Planning proceeding and could be used in that proceeding's Distribution Investment Deferral Framework (DIDF).	7/12/2017	No	Demand-side Management	$987,379	$987,379	$918,234	N/A	$918,234	$457,030	$0	San Diego Gas & Electric Company; Southern California Edison; Energy and Environmental Economics, Inc. (E3); Starboard Energy Advisors, LLC	$102,150	9.4%	Grant

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EPC-17-002 Scaling Solar+ for Small and Medium Commercial Buildings	Pre-existing intellectual property identified in agreement EPC-17-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Humboldt State University Sponsored Programs Foundation	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project is integrating DERs, including energy storage, and controllable loads to increase the value of Solar+ systems in the SMB sector. Optimized relative sizing of batteries to PV and flexible operations from model-predictive control (MPC)-enabled building automation will demonstrate how investment in an integrated system can save costs and create efficiency compared to standalone PV and storage. The project will develop and demonstrate an open-source MPC algorithm. Improved hardware-software interfaces will integrate the solar PV system with localized energy storage and MPC-improved load control systems. This will allow SMB owners to optimize the benefits of distributed solar and approach net-zero energy buildings while also supporting the larger grid power system.	1c, 1e, 1f, 1h, 1i, 2a, 3d, 3h, 5a, 5f	The solar + storage system has finished commissioning as of November 2019. Humboldt has conducted surveys of gas station / convenience stores across California to verify similar characteristics between sites and submitted a Convenience Store Survey Memo. Humboldt has also submitted a Cost Estimation Framework Memo that estimates the cost of installing similar solar + storage systems at other gas station / convenience stores, and forecasts how capital costs may decline over a 12-year period. Lawrence Berkeley National Labs has completed the development of the open-source model-predictive control (MPC) and submitted an MPC software report.
EPC-17-003 Developing a Comprehensive, System-Wide Forecasting to Support High-Penetration Solar	Pre-existing intellectual property identified in agreement EPC-17-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Clean Power Research, L.L.C.	Group 5: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project is advancing the state of PV forecasting in California by improving the accuracy of solar irradiance and PV forecasts, particularly rooftop solar, which was not currently well-understood. Participants in the Energy Commission's January 2017 forecasting workshop identified the lack of visibility into DER impacts on net load as a major barrier to generating accurate forecasts. Forecast inaccuracies cost California millions of dollars annually and result in the unnecessary curtailment of renewable generation.	1c, 2a, 3a, 5c	The project developed several forecast improvements by advancing methods for identifying low cloud layer front line motion and PV forecast uncertainty. The researchers also refined the Reconstituted Load Model, performed under a prior EPIC agreement, to account for systematic day-ahead forecast errors due to the misspecification of the solar PV generation impact. The study demonstrated that the accuracy of the existing Reconstituted Load models can be improved by replacing the unadjusted solar PV generation with statistically-adjusted solar PV generation data. The day-ahead forecast of the morning/evening, afternoon, and dawn hours are expected to have accuracy gains of 10%, 3%, and 8%, respectively. CAISO started running the Reconstituted Load model alongside their other production models to further inform day ahead load forecasting.
EPC-17-004 Enhanced Modeling Tools to Maximize Solar + Storage Benefits	Pre-existing intellectual property identified in agreement EPC-17-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Energy and Environmental Economics, Inc. (E3)	Group 3: Ranked # 1	N/A	N/A	Yes; Small Business, Calif Based Entity	This project developed a modeling tool, with feedback from Technical Advisory Committee members, that will enhance the existing Local Net Benefits Analysis tool developed by the project team under the CPUC's Distributed Resource Planning proceeding. The modeling tool is capable of simulating the operations of DERs under different tariff and program designs and determining the new designs that align the best uses of DERs for customers and for the grid and can maximize the benefits of DERs for ratepayers. The current planning tools do not consider how different tariff and program designs will affect DER locations and adoption rates that will affect system reliability and cost.	1a, 1b, 1c, 2a, 3b	The public release of the Solar + Storage Modeling Tool was completed in June 2019. E3 held two public workshops to introduce the tool. The first workshop in June, 2019, provided an introduction to the tool, reviewed the user guide and functionalities, and discussed how the tool can simulate and determine which design will maximize the benefits of DERs to ratepayers. The following workshop in August, 2019, provided an in-depth training for stakeholders interested in using the tool. E3 guided stakeholders through the process of creating inputs, analyzing the cases, and viewing the final results.There are discussions on using this tool in the Distribution Investment Deferral Framework process to target the cost-effective DER to those locations that provide the highest utility and ratepayer benefits.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-005 Integrating Building-Scale Solar + Storage Advanced Technologies Maximizing Value to Customer and the Distribution Grid	Applied Research and Development	This project assesses the performance and benefits of integrated solar photovoltaic and storage along with advanced energy efficiency, demand response, and distributed energy resource management technologies in a commercial building setting. The goal is to leverage the synergies of integrated and controllable components to improve distribution grid stability and reliability while also enabling the commercial customer to reduce both capital costs and operational and management costs for optimal value.	7/12/2017	No	Distribution	$1,491,764	$1,491,764	$300,415	N/A	$300,415	$360,079	$0	Electric Power Research Institute, Inc.	$271,090	15.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-006 Development, Implementation, and Integration of a Holistic Solar Forecasting System for California	Applied Research and Development	The project develops an improved forecasting system for solar irradiance in California, with a particular focus on fog and stratus conditions, through targeted deployment of instrumentation. The improved forecasts will be integrated into operational tools for use by the California Independent System Operator (CAISO) and utilities. This project utilizes a targeted instrumentation network, consisting of existing and new sensors, to improve the models used for forecasting fog and stratus conditions. The Recipient will design and deploy this network with the aim of improving the forecasts that are most important to CAISO and utility operations.	7/12/2017	No	Grid Operations/ Market Design	$749,740	$749,740	$113,581	N/A	$113,581	$365,395	$0	Electric Power Research Institute, Inc.; Sonoma Technology, Inc.; AWS Truepower, LLC	$324,830	30.2%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-007 Integrated Community Solar and Storage at a Low Income Mobile Home Park	Applied Research and Development	The Center for Sustainable Energy (CSE) planned to apply high efficiency solar and storage technologies to create an integrated community solar and storage energy system at a low income mobile home park. If this project had proceeded as planned, it would have illuminated operational strategies for solar and storage to provide clear value propositions to end-use customers with existing tariff structures and demonstrated alternate structures and additional value streams that could have increased the value of solar and storage to the end customer while better achieving distribution system operational goals.	7/12/2017	No	Grid Operations/ Market Design	$2,005,923	$2,005,923	$35,805	N/A	$35,805	$499,016	$0	Resident Owned Parks, Inc.	$340,905	14.5%	Grant

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EPC-17-005 Integrating Building-Scale Solar + Storage Advanced Technologies Maximizing Value to Customer and the Distribution Grid	Pre-existing intellectual property identified in agreement EPC-17-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	For California to achieve its long-term greenhouse gas reduction goals, there is a greater need for flexibility at all levels of grid operations. This project is demonstrating a suite of DER technologies, including solar + storage, with the capability for active and reliable control of customer-owned loads and resources to 1) reduce the building owner's energy bill and 2) reduce the need to build new transmission and distribution infrastructure that is often required to compensate for high loads and customer-side generation.	1h	The project site moved to the San Francisco Bay Area Council of the Boy Scouts of America, located in a disadvantaged community in San Leandro. The project team completed installation of circuit-level monitoring equipment and has begun collecting baseline energy performance data of the major loads in the building. They have completed the following deliverables: the DER-integrated design document, the test plan, the requirements definition document, the site readiness document, and the measurement and verification plan. The project team is currently finalizing the following deliverables: the energy data warehouse report, the software design document, and the tariff effectiveness methodology document. Completion of construction of the integrated DER system is expected by the end of 2019.
EPC-17-006 Development, Implementation, and Integration of a Holistic Solar Forecasting System for California	Pre-existing intellectual property identified in agreement EPC-17-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Electric Power Research Institute, Inc.	Group 5: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The use of an advanced network of existing and new instrumentation to inform numerical weather and statistical model improvements will significantly improve the current state of solar forecast modeling in California. The holistic forecasts produced will showcase a combination of various aspects of the weather forecast value chain, not previously demonstrated, linking observation systems and advanced physical and statistical modeling for solar forecasting. The project's focus on fog and marine layer forecasts, which are traditionally challenging to predict, will improve solar energy forecasting and contribute to increased PV penetration.	1b, 2a	The field data campaign included successful deployment of new sensors and integration of existing sensor networks. Unique data were collected during numerous summer and winter stratus episodes during 2018 and early 2019. The project team succeeded in using data storage solutions to facilitate real-time and historical data sharing. The team is investigating several research questions related to improving statistics-based solar radiation forecasting, such as on the role of the atmospheric boundary layer and which sensors provide the most added value in improving forecasts. The team developed machine-learning models to predict cloudiness and solar irradiance at Fremont for several forecast horizons, from 15 minutes to 2 hours, involving different independent variables available from the sensor data.
EPC-17-007 Integrated Community Solar and Storage at a Low Income Mobile Home Park	Pre-existing intellectual property identified in agreement EPC-17-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Center for Sustainable Energy	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project planned to design, install, and evaluate integrated high-efficiency solar panels with energy storage batteries, along with low-cost control hardware to demonstrate the impact of an integrated community solar and energy storage system in a low-income mobile home community. The project was designed to demonstrate the impact of an integrated community solar and energy storage system in a low-income community mobile home community to reduce net energy consumption and energy bills. A demonstration of a scalable solar and storage solution that provides clear value to residents is necessary to spur adoption of these clean energy technologies in the underserved mobile home residential sector.	3h	CSE was placed under a stop work order in July 2018. The stop work order was originally placed because the major subcontractor Horizon Solar Power (HSP) found that it did not budget for prevailing wage and was not allowed to increase labor rates. After an unsuccessful attempt to replace HSP with another subcontractor through a bidding process, CSE finally returned to HSP in January 2019 and worked out a solution by moving the prevailing wage positions to another subcontractor beneath HSP. CSE and HSP were working out changes to the budget when the site host dropped out of the project in May 2019. CSE identified a potential replacement site in July, but by November 2019, the site owner was unable to commit to hosting the project. Staff recommended mutual termination of the project in November 2019.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-008 Empowering Energy Efficiency in Existing Big-Box Retail/ Grocery Stores	Technology Demonstration and Deployment	This project demonstrates the impact of an integrated suite of pre-commercial energy efficiency technologies in a large, existing, retail building located near a disadvantaged community. One of the technologies that comprise the installation package includes a novel supervisory controller to provide system-wide optimization, to reduce electricity consumption across numerous building subsystems, including lighting, refrigeration, and heating, ventilation, and air-conditioning. This could enable site electricity savings of greater than 20%.	7/12/2017	No	Demand-side Management	$2,824,685	$2,824,685	$640,965	N/A	$640,965	$544,329	$0	Southern California Edison; TRC Engineers, Inc.; Software Motor Corporation; Walmart; LumaStream LLC	$759,984	21.2%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-009 Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California)	Technology Demonstration and Deployment	This project demonstrates three innovative bundles of pre-commercial technologies. The technology bundles were strategically developed through a systems-level approach to address the most energy-intensive areas in commercial buildings. These include: (1) Chilled Water Plants: Optimized all-variable-speed chilled-water (CHW) plants utilizing alternative refrigerant chillers. (2) Office and Exterior Space LED fixtures with integrated advanced controls, advanced building management system (BMS), and plug load controls controllable for demand response (DR), and off-grid, exterior, LED lighting in the parking lot, and lastly (3) Advanced laboratory ventilation, fume hood exhaust, and direct current (DC) lighting systems.	7/12/2017	No	Demand-side Management	$3,994,256	$3,994,256	$506,188	N/A	$506,188	$875,037	$0	Trane U.S., Inc.; ASWB Engineering; Willdan Energy Solutions; Aris Wind	$2,382,225	37.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-010 Integrated Heat and Moisture Calculation Tool for Building Envelopes	Applied Research and Development	The project develops software to enable building professionals to design better buildings, resistant to moisture accumulation issues and moisture-related damage. The goal is to develop tools that can be integrated with EnergyPlus/OpenStudio or similar design tools to reduce the time to specify, implement and verify the proper operation of control sequences. The project will integrate and build on existing software to use heat and moisture modeling in buildings that are exposed to natural climate conditions. The new software tool will offer will enable building design engineers to use energy-efficient ASHRAE-developed or custom control sequences for commercial buildings to verify correct implementation.	8/9/2017	No	Demand-side Management	$125,000	$125,000	$100,000	N/A	$100,000	$59,209	$1,375,175	None	$0	0.0%	Grant

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EPC-17-008 Empowering Energy Efficiency in Existing Big-Box Retail/ Grocery Stores	Pre-existing intellectual property identified in agreement EPC-17-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Center for Sustainable Energy	Phase 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project demonstrates how pre-commercial energy efficient technologies can deliver cost-effective, deep electric savings in a big-box retail environment, while also showcasing the demand reduction potential of these strategies. The project team will install a holistic suite of pre-commercial technologies such as a variable speed rooftop unit (RTU) high rotor pole switched reluctance (HRPSR) retrofit motor, direct current (DC) LED technology, direct-evaporative cooling to treat RTU condenser inlet air, and a cloud-based control system that will monitor all systems and detect energy waste, equipment malfunctions, and other operational problems. These technologies have the ability to demonstrate 20% energy savings.	1f, 1h, 2a, 3a, 4c	In 2019, the team identified LumaStream, LLC as the new DC lighting solution replacing Robert Bosch who dropped from the agreement. LumaStream will demonstrate a low-voltage, DC lighting solution that provides opportunities for simplified installation, more efficient centralized LED drivers and low energy consumption per lumen than conventional LED lighting installations. The team is modeling this solution with the current retrofit portfolio to see how much energy will be saved at the site. The team is procuring and installing the technologies for the demonstration site.
EPC-17-009 Bundle-Based Energy Efficiency Technology Solutions for California (BEETS for California)	Pre-existing intellectual property identified in agreement EPC-17-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Willdan Energy Solutions	Phase 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The demonstration project offers an innovative approach applicable to a range of commercial buildings. This strategy will accelerate adoption of energy savings technologies, contributing to reaching the state's energy efficiency and GHG reduction goals. By demonstrating this comprehensive approach in a real-world application this research has the potential to lead to further scale up and adoption of similar technology packages in other government and commercial buildings.	1f, 1h, 3b	The project continues to progress as expected. Both chillers and cooling tower retrofits will be complete by March 2020. Staff is coordinating a site visit for Spring of 2020.
EPC-17-010 Integrated Heat and Moisture Calculation Tool for Building Envelopes	Pre-existing intellectual property identified in agreement EPC-17-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Lawrence Berkeley National Laboratory	N/A ****	N/A	N/A	Yes; Calif Based Entity	The cost-effective modeling tool will enable improved envelope designs for new construction and retrofit applications, thus increasing building energy efficiency. As this project is jointly funded with the US Department of Energy, the developed tools have the potential to be broadly disseminated which could further the advancement of the developed software	1f, 1h	The team is working on the testing and verification of the software tool THERMM. The work being performed is to add user interface features to make THERMM more user friendly. They are fixing bugs and continue to work on connecting the software and the graphic user interface. Once connected, they will being the internal testing and they expect the outside testing can start in January/February. Testing is expected to be completed by June 2020.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-011 Demonstration of an Innovative, Community-Scale, Organic Waste-to-Energy Facility	Technology Demonstration and Deployment	The goal of the project is to construct and demonstrate operation of an innovative, state-of-the-art anaerobic digestion facility for converting organic waste into renewable electricity in San Luis Obispo County. The facility is the first of its kind in dry digester technology to be installed in the United States and is expected to process about 36,500 tons of food waste and urban waste into 6.2 million kWh per year of renewable electricity, 13,000 tons of compost, and 1.6 million gallons of liquid fertilizer leading to a host of environmental (e.g. reduction of 5,300 MT CO2e per year), economic, reliability, and safety benefits.	8/9/2017	No	Generation	$4,000,000	$4,000,000	$2,823,377	N/A	$2,823,377	$0	$0	HZIU Kompogas SLO Inc.	$5,278,373	56.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-012 Biomass-to-Electricity: Pilot-Scale Testing of Baseload Compared to Flexible Power	Applied Research and Development	The project tests and evaluates three different energy pathways for conversion of woody biomass to electricity. The three pathways tested with the pilot-scale gasifier system are: 1) clean fuel gas production for baseload power generation, 2) syngas to Fischer-Tropsch liquid production for storage and flexible power generation, and 3) direct bio-crude production for storage and flexible power generation. Results from the three pathways will be compared and an optimal pathway will be identified for extended testing. After performing extended testing of the optimal pathway, the technical, environmental, and economic performance of a full-scale facility will be evaluated.	7/12/2017	No	Generation	$1,499,000	$1,499,000	$1,141,799	N/A	$1,141,799	$254,980	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-013 Small Scale Forest Waste Power System	Applied Research and Development	This project develops a pilot-scale modular biomass power system called Altex Forest Power Technology (FORPOWER) that uses biomass from forest management as fuel to generate renewable electricity. FORPOWERis based on an indirectly-fired gas turbine technology that separates the fuel combustion products from the clean gas turbine working fluid by using a novel heat exchanger. The system uses forest slash as a renewable fuel while meeting criteria pollutant requirements, reducing greenhouse gas emissions, supporting renewable energy goals, and improving forest sustainability. FORPOWER is expected to cost-effectively convert forest slash to electric power and interconnect with the grid at distributed locations within investor-owned utility regions that are close to forest resources.	7/12/2017	No	Generation	$1,499,994	$1,499,994	$1,335,698	N/A	$1,335,698	$768,611	$0	Altex Technologies Corporation; The Avogadro Group, LLC	$161,728	9.7%	Grant

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EPC-17-011 Demonstration of an Innovative, Community-Scale, Organic Waste-to-Energy Facility	Pre-existing intellectual property identified in agreement EPC-17-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	HZIU Kompogas SLO Inc.	Group 3: Ranked # 1	N/A	N/A	No	This project will benefit California ratepayers by demonstrating an innovative, state-of-the-art anaerobic digester facility. Once economical operation is proven, similar facilities can be replicated across California to provide similar benefits to other local communities.	1a, 1b, 1c, 2a, 3a, 3b, 3g, 3h, 4a	The project team completed construction of the anaerobic digester (AD) facility in San Luis Obispo in October 2018. The facility currently converts 700 tons of green waste and food waste per week into 465kWh of renewable electricity on average. The BioMAT PPA agreement was executed in July 2019 and facility has since been selling power to PG&E at a price 12.7 cents per kWh. In addition, the facility produces compost, and has been selling it to wineries.
EPC-17-012 Biomass-to-Electricity: Pilot-Scale Testing of Baseload Compared to Flexible Power	Pre-existing intellectual property identified in agreement EPC-17-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Taylor Energy	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will test and evaluate new biomass-to-energy pathways, which is critical to meeting several of California's energy goals and provides numerous economic, environmental, and safety benefits to California ratepayers.	2a, 3a, 3b, 3e, 4a	The project team has completed initial system modifications and has performed testing of the first pathway - clean fuel gas production for baseload power generation. The project team is performing system modifications required for testing of the other two pathways. The contractor has completed gas clean-up and carbon-char removal systems, while testing biomass gasification.
EPC-17-013 Small Scale Forest Waste Power System	Pre-existing intellectual property identified in agreement EPC-17-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Altex Technologies Corporation	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Integrating a low cost feedstock densification approach and innovative heat exchanger with gasifier and externally-fired gas turbine to efficiently generate electricity from forest slash will provide multiple benefits to California investor-owned utility ratepayers, including reduced power cost relative to alternative approaches, improved electric power generation reliability, reduced risk of forest fires and pollutant emissions, and improved economic development opportunities in forested regions.	1a, 2a	FORPOWER densification and bioenergy modules have been built and tested. System biomass testing will continue and data will be collected. The work is progressing, but has been delayed due to a generator power output problem and a biomass feeding problem. Both problems have been corrected. System biomass testing will continue and data will be collected to determine the potential of the concept to convert forest slash into power.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-014 Advanced Plug Load Controls and Management in the Educational Environment	Technology Demonstration and Deployment	This project deploys APMD technology at approximately 3,500 computer workstations at several community colleges, and focuses on integrating the technology with facility operations to ensure that they meet the needs of the sites and staff. One of the devices that will demonstrated is the Embertec Tier 2 Advanced Power Strip which will control an occupant's computer workstation. The other device is the Ibis Intellisocket which controls large plug load end uses such as water coolers, TV displays, and large printers. Key features of the proposed project include outreach and individual education programs to California Community College Districts, evaluation of sites for participation in the project, purchase and installation of APMDs at approved sites, measurement and verification (M&V) activities both pre- and post-APMD implementation at the selected demonstration sites.	8/9/2017	No	Demand-side Management	$5,000,000	$5,000,000	$1,074,444	N/A	$1,074,444	$181,505	$0	Ibis Networks; Newcomb Anderson McCormick, Inc.; Embertec	$625,486	33.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-014 Advanced Plug Load Controls and Management in the Educational Environment	Technology Demonstration and Deployment	This project deploys APMD technology at approximately 3,500 computer workstations at several community colleges, and focuses on integrating the technology with facility operations to ensure that they meet the needs of the sites and staff. One of the devices that will demonstrated is the Embertec Tier 2 Advanced Power Strip which will control an occupant's computer workstation. The other device is the Ibis Intellisocket which controls large plug load end uses such as water coolers, TV displays, and large printers. Key features of the proposed project include outreach and individual education programs to California Community College Districts, evaluation of sites for participation in the project, purchase and installation of APMDs at approved sites, measurement and verification (M&V) activities both pre- and post-APMD implementation at the selected demonstration sites.	8/9/2017	No	Demand-side Management	-$3,735,704	-$3,735,704	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-015 Installation and Soft Cost Reduction for Horizontal Single Axis Trackers (Stage II)	Technology Demonstration and Deployment	This project is demonstrating a novel single axis solar PV tracking system suitable for sloped and rolling terrain. This will help solar developers build projects on lands closer to load centers and interconnection points that typically would not be considered, creating more site options. The construction costs are reduced by eliminating the need for grading soil and environmental mitigation costs can be cut as well. The new tracker was developed through a DOE award and a full-scale system is under testing at a rolling terrain near Davis, CA. The Energy Commission grant is funding improvements and testing of the various tracker components in an effort to find cost-cutting opportunities to update the product design and optimize it for full-scale manufacturing.	8/8/2017	No	Generation	$999,822	$999,822	$888,985	N/A	$888,985	$76,846	$2,999,466	None	$0	0.0%	Grant

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EPC-17-014 Advanced Plug Load Controls and Management in the Educational Environment	Pre-existing intellectual property identified in agreement EPC-17-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Newcomb Anderson McCormick, Inc.	Phase 2: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Reductions in electricity consumption and cost could be delivered to the participating Community College Districts via the implementation of the APMD technology. The savings will accrue as the devices are deployed in a phased approach, and be fully achieved once the EPIC project is complete. Following project completion, the APMD systems will continue to provide savings throughout their 8 to 10 year expected useful life. Successful deployment at participating Districts could be leveraged to expand technology adoption to other community colleges.	1f, 1h, 2a	The recipient nearing the final installation of the units at all participating community colleges and will start 1-year of post-installation monitoring and evaluation to verify the energy reduction of the plug load controls.
EPC-17-014 Advanced Plug Load Controls and Management in the Educational Environment	Pre-existing intellectual property identified in agreement EPC-17-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 2: 13 out of 15 bidders	Newcomb Anderson McCormick, Inc.	Phase 2: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	Reductions in electricity consumption and cost could be delivered to the participating Community College Districts via the implementation of the APMD technology. The savings will accrue as the devices are deployed in a phased approach, and be fully achieved once the EPIC project is complete. Following project completion, the APMD systems will continue to provide savings throughout their 8 to 10 year expected useful life. Successful deployment at participating Districts could be leveraged to expand technology adoption to other community colleges.	1f, 1h, 2a	The recipient nearing the final installation of the units at all participating community colleges and will start 1-year of post-installation monitoring and evaluation to verify the energy reduction of the plug load controls.
EPC-17-015 Installation and Soft Cost Reduction for Horizontal Single Axis Trackers (Stage II)	Pre-existing intellectual property identified in agreement EPC-17-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Nevados Engineering, Inc.	N/A ****	N/A	N/A	Yes; Calif Based Entity	This project focused on creating products to facilitate the move from flat land installation sites to non-flat land sites to accelerate the growth of solar installations leading the state to a 100% clean energy future.	1e, 2a, 3a, 3b, 4a	The project team completed substantial work on the All-Terrain Tracker and the product is now commercially ready. However, further work will continue to bring down the costs, expand the product capability, and expand the products offered. The version of the product that was ready at the end of the project includes a single axis tracker that can fit to flat, sloped, and rolling terrain on slopes of up to 37% grade and with changes in slope along the length of the row of up to 17% grade at each bearing assembly. The team has also developed software products for optimum operation and control and remote monitoring. These products are commercially ready to enable sale, manufacturing, and deployment of the tracker. Nevados has already sold and installed the new tracker system at several customer sites.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-016 An Online Siting Tool Application for Woody Biomass-to-Electricity Facilities in California	Applied Research and Development	This project develops a decision support system that will reduce the soft costs of estimating and planning new bioenergy power plants that consume woody biomass from sustainable forest management activities. The open-source facility-siting tool will be hosted online and will allow users to quickly evaluate economic feasibility and environmental performance potential of particular locations for developing a wood-based biomass power plant. The project includes case study analysis to understand feasibility and barriers to developing biopower facilities in high-risk hazard zones.	8/9/2017	No	Generation	$1,222,284	$1,222,284	$74,471	N/A	$74,471	$203,977	$0	Regents of University of California, Davis	$28,523	2.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-017 The Nexus of Clean Energy, Healthy Forests, and a Stable Climate: Innovative Biomass Gasification for Sustainable Forest Management	Applied Research and Development	This project supports the development of the Powertainer+ (PT+) -- a multi-modal power and products platform designed to generate low-cost renewable energy, process thousands of tons of forestry waste, and sequester carbon. The Powertainer+ will include a combined heat and power module, increase the power capacity (from 150kW to between 210-250kW), and increase the forestry waste processing capacity to up to 2200 bone dry tons per year.	10/11/2017	No	Generation	$1,500,000	$1,500,000	$849,563	N/A	$849,563	$0	$0	Humboldt State University Foundation, Schatz Energy Research Center; All Power Labs, Inc.; Anderson Biomass Complex	$750,000	33.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-018 Demonstrating the Potential for On-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units	Technology Demonstration and Deployment	This project assesses the potential for a highly standardized and rapidly deployable decentralized AD solution as a compelling alternative to large-scale centralized AD facilities. By implementing on-site AD at locations where food waste is generated and electricity demand exists, it is possible to reduce or avoid 1) the consumption of non-renewable electricity, 2) the transmission and distribution (T&D) losses associated with the delivery of electricity across long distances on the regional grid, and 3) the transport costs (inclusive of the monetary, environmental, and public health costs) of hauling food waste long distances to feed larger AD generators.	9/13/2017	No	Generation	$2,411,007	$2,411,007	$29,549	N/A	$29,549	$171,649	$0	UC Davis; Biodico, Inc.; SeaHold, LLC	$756,133	23.9%	Grant

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EPC-17-016 An Online Siting Tool Application for Woody Biomass-to-Electricity Facilities in California	Pre-existing intellectual property identified in agreement EPC-17-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	The Regents University of California, Davis	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project will increase the cost competitiveness of biopower plant projects, resulting in expanded opportunities for using biomass waste streams. The online and open application architecture will ensure that everyone has open, public access to this resource.	1a, 1b, 1c, 3b, 3h, 4a, 5d, 5e	UCD's request to the U.S. Forest Service (USFS) Pacific Northwest Resource Monitoring and Assessment team to use the latest "LEMMA LT-GNN" spatial forestry inventory data was denied. Instead of this data, UCD has decided to base its project siting support tool on the "F3" model data developed by the USFS's Region 5 Remote Sensing Lab. The F3 data is currently limited to the Sierra Nevada region, but the F3 team plans to expand the data to all of California. UC Davis is now focused on developing a pilot version of its tool for the Sierra Nevada, then expanding the tool for the rest of California once the respective F3 data is released.
EPC-17-017 The Nexus of Clean Energy, Healthy Forests, and a Stable Climate: Innovative Biomass Gasification for Sustainable Forest Management	Pre-existing intellectual property identified in agreement EPC-17-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	All Power Labs, Inc.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Broadly, the goals of this project are to decrease the modular technology platform's levelized cost of electricity, increase its forestry residue processing capacity, add new value streams in the forms of hot water and biochar production, and enhance the system's carbon sequestration capacity.	1a, 1f, 3g, 4a, 4e	The team identified critical areas that require validation testing to ensure safe and efficient operation of the PT+ and CCHP modules. The team designed the pre-combustion biochar off-take and conducted a bench-scale test. The biochar test data showed that the system met the char yield target of less than 20%. A combined heat power system is being designed to increase the system efficiency. With all systems running nominally using walnut shells at 50kWe, practically zero tar was measured under high and low char yield rates.
EPC-17-018 Demonstrating the Potential for On-Site Electricity Generation from Food Waste Using Containerized Anaerobic Digestion Units	Pre-existing intellectual property identified in agreement EPC-17-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	The Regents University of California, Davis	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project addresses the knowledge gap regarding the optimal scale for the deployment and use of AD technology to convert food waste into renewable electricity, heat, and fertilizer. To meet this need, researchers will perform techno-economic and environmental assessments of increased deployment of micro-scale AD systems across the state. Researchers will also develop new information about the performance variability of micro-scale AD systems relative to fluctuating and heterogeneous food waste feedstock inputs.	1a, 1b, 2a, 3b, 3g, 4a, 4e	UC Davis (UCD) has successfully received permit approval for the Oxnard site. The entire equipment system - anaerobic digester, biogas treatment, microturbine, and CHP system - has been successfully integrated at Impact Bioenergy's equipment manufacturing site. The equipment will be delivered to the Oxnard site for installation and commissioning. UCD completed its site design, Measurement and Verification Plan, Execution Plan, and Operations Manual. UCD has been conducting initial food waste assessments to understand baseline methane generation potential and has presented information on the project to interested stakeholders at several conferences, including FOODIE and ISSST.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-019 Burney-Hat Creek Bioenergy	Technology Demonstration and Deployment	This project seeks to bring West Biofuels gasification technology, a technology funded by EPIC under an applied research and development program grant (EPC-14-024), to full commercialization. The West Biofuels gasification solution is designed to utilize forest derived biomass and is ready for scale-up demonstration and deployment. To advance its commercial readiness, this project is developing and demonstrating a community-scale forest biomass facility in the Burney-Hat Creek region that is designed to address the need for increased markets for forest biomass resources. The bioenergy facility will be consistent with the requirements of the BioMAT Category 3 and obtain a power purchase agreement at a financially viable price. The plant will consume about 22,000 bone dry tons (BDT) of forest sourced feedstock per year, generate 2.88 MW of renewable energy at full rated capacity, and have a capacity factor that is greater than or equal to 75 percent.	9/13/2017	No	Generation	$5,000,000	$5,000,000	$87,037	N/A	$87,037	$0	$0	Hat Creek Bioenergy, LLC	$5,000,000	50.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-020 Demonstration of Vehicle-Grid Integration under Non-residential Scenarios	Technology Demonstration and Deployment	This agreement will demonstrate vehicle-grid integration in non-residential facilities to show the flexibility of smart charging. The team will build and validate models that incorporate usage patterns, quantify the impacts of EV charging, develop controls to manage the smart charging to minimize grid impacts and utility costs, and calculate the value streams and costs associated with realizing those value streams.	9/13/2017	No	Distribution	$2,340,000	$2,340,000	$1,577,643	N/A	$1,577,643	$728,697	$0	UC Santa Barbara; Google.Inc; Kisensum; ChargePoint, Inc.; Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)	$597,593	20.3%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-021 Mariposa Biomass Project	Technology Demonstration and Deployment	This project is designing and constructing a thermochemical biomass-to-energy conversion facility for forest wood waste that will have a capacity between 2.0 and 2.4 megawatt (MW) annually and produce between 15,000 to 18,500 MWh annually of renewable, community-scale, grid-connected electricity. The project demonstrates and optimizes this forest waste bioenergy technology and assesses the performance characteristics and best practices when using wood waste from forest management as feedstock. The project is located in Mariposa, CA -- often referred to as ground zero for the tree mortality disaster -- and will use forest biomass obtained from a high fire hazard zone.	3/21/2018	No	Generation	$5,000,000	$5,000,000	$37,140	N/A	$37,140	$8,842	$0	Cortus Energy	$11,135,367	69.0%	Grant

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EPC-17-019 Burney-Hat Creek Bioenergy	Pre-existing intellectual property identified in agreement EPC-17-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Fall River Resource Conservation District	Group 2: Ranked # 2	N/A	N/A	No	The Burney-Hat Creek Bioenergy facility will be the first commercial deployment of an innovative gasification system that integrates a horizontally positioned rotary gasifier based off a torrefaction reactor, a thermal oxidizer and an Organic Rankine Cycle (ORC) technology in place of internal combustion engine. The technology is expected to overcome important challenges with the use of forest-sourced wood, including environmental compliance and operating challenges that are hindering large scale bioenergy projects. Under a previous R&D project, West Biofuels took a measured and strategic approach to designing modular gasification system for forest materials, which brings the selected gasification technology from research to commercial operation.	1a, 1b, 2a, 3g, 3h, 4a, 4b, 4e	The project team continued to advance a variety of project elements. All interconnection study information has been supplied to PG&E. There has been progress on the interconnection and project finance, although the interconnection agreement is still pending. The preliminary engineering package for the project and the construction cost estimate has been completed by West Biofuels on behalf of Hat Creek Bioenergy. The interconnection agreement expected to be finalized by end of January 2020.
EPC-17-020 Demonstration of Vehicle-Grid Integration under Non-residential Scenarios	Pre-existing intellectual property identified in agreement EPC-17-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Board of Trustees of the Leland Stanford Junior University (SLAC National Accelerator Laboratory)	Group 4: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The project will develop and demonstrate advanced model-predictive control strategies that are more sophisticated than the current state of the art technology by incorporating usage patterns, quantifying the impacts of EV charging while managing the smart charging, and calculating the value streams/costs. This project will demonstrate how to minimize electric vehicle charging effects on the distribution system while analyzing EV fleet capabilities under non-residential scenarios.	1h, 3f, 4b	The SLAC team developed and demonstrated a model to show how the distribution transformers are aging due to unmanaged EV charging sessions at three different demonstration sites: SLAC, Stanford, and Google. With the real-time data obtained from each site, the team was able to develop smart charging software to optimize EV charging events. The software helped the Stanford Campus operate and optimize its large fleet of EV buses by improving bus schedules and routes. The project team implemented the software at the Google campus to quantify the potential benefits of controlled charging sessions at its large parking facility.
EPC-17-021 Mariposa Biomass Project	Pre-existing intellectual property identified in agreement EPC-17-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Mariposa County Resource Conservation District (MCRCD)	Group 2: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The Mariposa Biomass Project has partnered with Cortus Energy to demonstrate an innovate gasification system trademarked as WoodRoll technology. The technology uses a 3-stage drying, pyrolysis and gasification process to produce a clean high BTU syngas, thus reducing costly engine maintenance costs and outages; and the gasification facility will integrate automation and remote monitoring to further reduce operating costs. The WoodRoll facility will have 16 standardized factory-tested modules that can be installed quickly and moved if necessary. The combination of high efficiency and availability combined with low operating and maintenance costs will allow the Mariposa Biomass Project to be a financially successful small-scale forest biomass demonstration facility that can be replicated in other rural areas with access to sustainable forest biomass supplies.	1a, 1b, 3g	The project team successfully entered PG&E's BioMAT queue in October 2019. PG&E is reviewing this application and the project team is awaiting the execution of the power purchase agreement. Development of a sister plant by the project's major subcontractor, Cortus Energy, has been completed and fully commissioned. Once the power purchase agreement with PG&E is executed, the components will be shipped to the designated plant site in Mariposa County.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-022 Skid Mounted Mobile Pilot/Education Unit for Source Separated Organics Processing with Cogeneration Capabilities	Technology Demonstration and Deployment	The purpose of this project is to construct and demonstrate an innovative technology to pretreat organic wastes prior to anaerobic digestion at a wastewater treatment facility to enhance operational efficiencies and increase biogas production. The pretreatment technology will be constructed as skid-mounted mobile units for processing source-separated organic wastes and biosolids and will have cogeneration capabilities, thereby further increasing the energy generation from the wastewater treatment system	11/8/2017	No	Generation	$1,589,163	$1,589,163	$908,502	N/A	$908,502	$19,396	$0	GHD, Inc.; Lystek International Limited; Design2Operate	$493,075	23.7%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-023 High Performance, Ultra-Tall, Low Cost Concrete Wind Turbine Towers Additively Manufactured On-Site	Applied Research and Development	This project aims to develop and test a reinforced concrete additive manufacturing (RCAM) technology for building low cost ultra-tall wind turbine towers onsite at a wind plant. Taller wind turbine towers capture more wind energy from faster winds aloft, but are constrained by transportation size and weight. The key goal is to develop a RCAM technology that can be used to fabricate a wind turbine tower on-site in one day at half of the cost of conventional steel towers, and reduce the levelized cost of wind generated electricity in a low wind speed site by 11%.	11/8/2017	No	Generation	$1,249,982	$1,249,982	$323,646	N/A	$323,646	$164,368	$0	Jason Cotrell, dba RCAM Technologies	$62,558	4.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-024 Electric Access System Enhancement (EASE)	Technology Demonstration and Deployment	Distributed control capabilities will enable distributed intelligence and control capability to support fast, automated decisions and improve overall resiliency of the system. This project implements a plug and play concept to facilitate service discovery from PV and batteries both under direct control and being controlled via aggregator to streamline all interconnection types and rationalize multiple systems and processes. In addition, the project explores and demonstrates distributing the existing enterprise functions, i.e. state estimation and optimization, out on the distribution system and to the edge, where necessary and desirable to securely operate the system closer to limits. This project is a federal cost share project to SCE's EASE project under U.S. DOE's ENERGISE program.	1/17/2018	No	Distribution	$2,000,000	$2,000,000	$0	N/A	$0	$75,160	$8,188,000	None	$0	0.0%	Grant

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EPC-17-022 Skid Mounted Mobile Pilot/Education Unit for Source Separated Organics Processing with Cogeneration Capabilities	Pre-existing intellectual property identified in agreement EPC-17-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Lystek Internationa l Limited	Group 3: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project will combine the organic processes and anaerobic digestion that will yield greater biogas generation and utilization resulting in higher diversion of organic wastes while producing more renewable electricity than conventional digester systems. If successful, the combined technologies will provide wastewater treatment operators with greater confidence in working with organic generators and processors for accepting feedstock material suitable for co-digestion.	1a, 2a, 4a, 4e, 5b	The project is running in good standing. The project's air permit was received in August. Commissioning of the equipment occurred in July and August of 2019 and started operations on August 26, 2019 with commissioning of the demonstration digesters. The first delivery of food waste from UC- Santa Barbara was on August 27, 2019. They have been slowly feeding the test digesters since start-up and reached optimum capacity in December 2019. They are now recording measureable volumes of biogas as expected. Plan is to operate at this steady level for the duration of the project and prepare for the energy conversion unit portion. The next step for the project is the energy conversion of biogas to electricity. This should occur sometimes in March 2020.
EPC-17-023 High Performance, Ultra-Tall, Low Cost Concrete Wind Turbine Towers Additively Manufactured On-Site	Pre-existing intellectual property identified in agreement EPC-17-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	19 out of 19 bidders	RCAM Technologie s	Ranked # 1	N/A	N/A	No	Substantial recent investments and advancements in concrete additive manufacturing technologies for buildings make this an opportune time to use the RCAM technology for constructing tall wind turbine towers in California. Concrete additive manufacturing technologies are being developed by countries around the world; however, most development has been performed on concrete printing manufacturing methods for buildings that have little or no structural reinforcement necessary. The project team will build upon the state-of-the art technology to develop the innovative RCAM method that incorporates reinforcement in concrete printing for ultra-tall turbine towers.	2a	The project team built a three-dimensional finite element model for a baseline 158-meter wind turbine tower and 158-meter 3D concrete printed wind turbine tower. The considered loading conditions include wind load, seismic load, and dead load of the structure. The model will be used to predict structural behavior such as maximum displacement, load carrying capacity, and maximum stress. The team is also developing and testing prototypes of concrete tower sections. Preliminary concrete mixes and prototypes were built with a mini robot 3D Potterbot and they were mechanically tested in the laboratory. In subsequent phases, the project team will be building and testing larger prototypes.
EPC-17-024 Electric Access System Enhancement (EASE)	Pre-existing intellectual property identified in agreement EPC-17-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	Southern California Edison	N/A ****	N/A	N/A	Yes; Calif Based Entity	This project will form an architecture and cooperative framework enabling a "system of systems" approach that streamlines the integration of DERs from planning to operations and enables cross optimization between different participants (IOU, third-party DER owners, CAISO) to allow exchange of services and improved use of assets.	1d, 1g, 1h, 1i, 3f, 3h, 5b	The agreement was executed in July 2019, and the kickoff meeting was held in August 2019. The subcontractor KITU Systems has completed its customer enrollment plan and developed its system design specifications and integration test plan.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-025 TradePro Connect Product and Service Procurement Project	Market Facilitation	This project is creating TradePro Connect - an online platform that provides a marketplace that facilitates tailored connections between customers and service providers. It empowers customers to find qualified contractors serving their area; request, evaluate and select bids; and schedule services. Contractors enrolled in the platform will gain access to new work opportunities, an ability to represent their certifications and training, and membership in an exclusive clean energy Group Purchasing Organization. The project aims to enroll a minimum of 100 contractor organizations on the platform, directing at least 30 jobs to small, disabled veteran, minority, LGBT and/or women business enterprises; as well as implement at least 50 projects during the project period. TradePro Connect is being demonstrated by facilitating projects for the SOMAH and SCE Auto DR programs as well as service-territory-agnostic On-Bill Financing (OBF) functionality.	3/21/2018	No	Grid Operations/ Market Design	$991,110	$991,110	$704,748	N/A	$704,748	$159,260	$0	ASWB Engineering; Cohen Ventures Inc. dba Energy Solutions; Qmerit; ProQure; Ecometes	$994,084	50.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-026 Accelerating the Adoption of EVs as DERs through Fleet Procurement	Market Facilitation	The MyFleetBuy fleet procurement system developed in this project will mitigate uncertainties for fleet managers by providing clarity on cost savings offered by EVs and smart charging, and verifying the range viability of EVs. MyFleetBuy will leverage the sophisticated vehicle physics models underlying the LBNL-developed MyGreenCar technology, analyzing individual fleet vehicle duty cycles and translating the analysis into easy-to-understand graphics. MyFleetBuy will provide fleet managers with a low cost, highly scalable data collection and analytics system with which to compare their options when investing in new vehicles. The platform will accelerate fleet procurement of EVs by raising awareness of options while mitigating the uncertainties that limit their adoption in fleets.	3/21/2018	No	Grid Operations/ Market Design	$1,000,000	$1,000,000	$713,641	N/A	$713,641	$115,875	$0	Caltrans; County of Alameda; City of Oakland Bureau of Infrastructure and Operations	$1,779,718	64.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-027 The Distributional Electricity Impacts of Climate Change on California's Residential Communities	Applied Research and Development	This project studies the impacts of rising temperatures on electricity demand and the related emissions of pollutants from current generation stations. On the demand side, the researchers are creating an empirically calibrated statistical model using household level data to estimate household response of electricity demand to temperature. On the supply side, the study is estimating the implications of the increased intensity and frequency of extreme heat events from climate change on peak demand and local air pollutants, GHG emissions, and costs of generating capacity in the absence of policy intervention or technology change.	3/21/2018	No	Generation	$200,000	$200,000	$134,790	N/A	$134,790	$36,240	$0	None	$0	0.0%	Grant

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EPC-17-025 TradePro Connect Product and Service Procurement Project	Pre-existing intellectual property identified in agreement EPC-17-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Cohen Ventures Inc. dba Energy Solutions	Group 4: Ranked # 1	N/A	N/A	Yes; Small Business	By streamlining the customer's buying experience, working with the supply-chain to stock and promote best-in-class products, and ensuring proper design, installation, commissioning, operation and maintenance, the project reduces the cost and risk of DER technology procurement which increases adoption. This leads to lower energy use and GHG emissions and also facilitates compliance with SB 350's Responsible Contractor Policy.	1c, 3b	The project team soft-launched the TradePro Connect and Manage Your Power landing pages. Currently, there are two utility programs ready to be supported with the platform: Southern California Edison (SCE) Automated Demand Response (Auto-DR) and CPUC's Solar on Multifamily Affordable Housing (SOMAH). Additionally, On-Bill Financing integration is in the process of being added as a non-utility branded program. As of September 2019, 100 service providers were on the TradePro Connect platform. To encourage projects, TradePro Connect is working with SCE to offer customers free smart thermostats with optional Auto DR integration for additional savings. To get the offer, customers and service providers would have to use TradePro Connect to execute the project, after connecting to each other in TradePro Connect's online bid process.
EPC-17-026 Accelerating the Adoption of EVs as DERs through Fleet Procurement	Pre-existing intellectual property identified in agreement EPC-17-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Lawrence Berkeley National Laboratory	Group 4: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	MyFleetBuy will raise fleet managers' awareness of EVs while mitigating the risks and uncertainties that inhibit their adoption of EVs. MyFleetBuy will (1) collect high-resolution data on individual fleet vehicles, including driving distances, traffic, terrain, driving style, and more, using low-cost data loggers; (2) analyze these data with sophisticated vehicle physics models; and (3) provide fleet managers with a decision-support tool to compare fuel costs of conventional, hybrid, or EVs; compare overall operating costs for all vehicles; and, calculate the difference in costs of uncontrolled vs. smart charging for EVs.	3a, 4a, 5b	In 2019, the recipient made significant progress on market discovery, customer development, and securing market traction for MyFleetBuy (MFB).The recipient created a functional prototype of MFB, and has integrated the software with the Alameda County, City of Oakland, and CalTrans pilot fleets' telematics data.The MFB team has also secured a contract with the National Science Foundation to develop the underlying physics models of MFB and a grant from the City of Fremont to use MFB for municipal fleet electrification. Furthermore, Green Light Labs has taken on MyFleetBuy from LBNL in an effort to commercialize the technology. In 2020, the recipient plans to: continue development and pilot testing of MFB to fleet partners; continue market discovery with fleet managers; and continue business development to secure contracts and partnerships to scale MFB to government fleet managers.
EPC-17-027 The Distributional Electricity Impacts of Climate Change on California's Residential Communities	Pre-existing intellectual property identified in agreement EPC-17-027 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Berkeley	Group 4b: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will generate new and precise estimates of the forecasted damages to California's residential communities due to climate change. This will create a scenario in the absence of additional standards and policies (e.g., additional emissions abatement requirements) and hence create a baseline for calculating their value. These two approaches will provide the most comprehensive analysis of the impact of climate change on California's residential communities and particularly on disadvantaged communities.	2a	The researchers have completed running their statistical model for electricity demand in response to climate change. They are now completing the analysis of electricity generation and emissions under climate change.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-028 High Resolution Source Importance Mapping to Minimize Impacts of Waste Biomass Distributed Generation on Ozone Air Quality in Disadvantaged Communities in the San Joaquin Valley	Applied Research and Development	This research includes high-resolution mapping of local and regional sources that influence ozone pollution in disadvantaged communities and non-attainment areas in the San Joaquin Valley across diverse weather conditions. The researchers will use a 3-D chemical transport modeling system in a number of simulations to determine location-dependent emission limits for bioenergy distributed generation deployment needed to protect the public health of disadvantaged communities and meet federal ozone standards. A decision support model will be developed to aid planners in siting distributed bioenergy generation and mitigating associated impacts.	3/21/2018	No	Generation	$200,000	$200,000	$181,531	N/A	$181,531	$89,052	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-029 Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy	Applied Research and Development	This agreement funds a core team of scientists, students, and staff from computer science and marine biology to perform three main development tasks that will lead to open-source artificial intelligence classification capabilities: 1) performing custom convolutional neural network training focused on a number of key benthic species using an iterative training process to improve the accuracy of the prediction model; 2) developing "intelligent" video/image annotation tools to augment the capabilities of existing Video Annotation Reference System from the Monterey Bay Aquarium Research Institute to streamline annotation/classification workflows; and 3) moving the annotation software, workflow, and tools to the cloud to provide widespread adoption and customization capabilities for the broader scientific and consulting community.	3/21/2018	No	Generation	$199,978	$199,978	$138,350	N/A	$138,350	$29,057	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-030 California Opportunities for Procurement to Accelerate Clean Energy (Cal-OP ACE)	Market Facilitation	This project will establish a new incubator program specifically geared towards bridging the gap between California clean energy companies and institutional/commercial customers that rely on formal procurement processes to purchase DER solutions and packages. The project will provide and coordinate key services, assistance, and resources needed to bridge the gap between emerging energy technology solutions and large-scale procurement processes. Cal-OP ACE will provide support to clean energy ventures navigating and competing in institutional energy procurement processes, while providing guidance to customers updating and streamlining their procurement processes for advanced DER technologies. Cal-OP ACE will be responsible for facilitating information sharing so clean energy ventures are aware of market opportunities provided by institutional customers; and institutional customers are aware of new DER technology features that can address their critical needs.	3/21/2018	No	Demand-side Management	$3,998,715	$3,998,715	$872,421	N/A	$872,421	$128,875	$0	Energy Solutions; Lawrence Berkeley National Laboratory; Prospect Silicon Valley; TerraVerde; Ecomedes; California State University - Office of the Chancellor	$1,244,450	23.7%	Grant

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EPC-17-028 High Resolution Source Importance Mapping to Minimize Impacts of Waste Biomass Distributed Generation on Ozone Air Quality in Disadvantaged Communities in the San Joaquin Valley	Pre-existing intellectual property identified in agreement EPC-17-028 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Lawrence Berkeley National Laboratory	Group 4a: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This study maps both local and upwind emission sources that contribute to ozone air pollution in disadvantaged communities (DAC) and uses the source importance mapping to develop site-specific ozone mitigation strategies.	2a, 4b	The researchers have developed the modeling protocol and are conducting modeling simulations and assessing ozone impact metrics. A report on the modeling simulations was submitted.
EPC-17-029 Lowering Costs of Underwater Biological Surveys to Inform Offshore Renewable Energy	Pre-existing intellectual property identified in agreement EPC-17-029 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Cal Poly Corporation	Group 4b: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project provides advanced tools to scientists to facilitate the efficient collection of higher quality data that will provide regulators, decision makers, and the public with greater scientific certainty regarding the impact of marine renewable energy on California's marine ecological resources. Reducing the regulatory uncertainty of marine renewable energy production will provide decision makers with better information about impacts of offshore renewables as California seeks to achieve its Renewables Portfolio Standard (60% renewable electricity by 2030) and the 100% renewable and zero-carbon electricity goal established in Senate Bill 100.	2a, 4f	The project team is nearing completion of the development of the video annotation software and annotating the pilot underwater video from the Monterrey Bay Aquarium Research Institute. They developed the machine learning portion of the project to automate the identification of target species in the video. They are fine-tuning the machine learning algorithm to achieve the desired accuracy level. Computer science students are gaining real-world experience coding the software, while marine biology students are learning to identify species in the underwater video. A no-cost time extension was approved to extend the project to July 2020.
EPC-17-030 California Opportunities for Procurement to Accelerate Clean Energy (Cal-OP ACE)	Pre-existing intellectual property identified in agreement EPC-17-030 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Prospect Silicon Valley	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The need for connecting DERs to Integrated Demand Side Management (IDSM) strategies has been well-established in the following state policy contexts: 1) California energy code (Title 24) requirements for building controls and demand response (DR) capabilities; 2) AB 802 requirements for utilities to shift to Normalized Metered Energy Consumption (NMEC) to inform more rigorous utility pay for performance efficiency programs; 3) SB 350 doubling energy efficiency targets and rolling out a responsible contractor policy to ensure proper installation and commissioning of DERs; and 4) AB 793 energy management technology requirements.	1c, 1f, 2a, 3e	Since the project started in August 2018, Prospect Silicon Valley has developed two critical surveys for institutional buyers and DER technology providers to assess buyers' awareness of existing procurement programs, opportunities for improvement, and requirements for institutional procurement. Moving forward, the project work will concentrate on creating and implementing Procurement Initiatives that will address the barriers identified from the surveys. These Procurement Initiatives will be scoped to streamline the adoption of DER technologies through formal procurement processes by improving access to product and service information, developing effective contract language, and establishing goals and procurement roadmaps based on benchmarking.

Invest-ment Program Period	Program Admin-istrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immed-iately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date: Contract/ Grant Amount ($)	Funds Expended to date: In house expend-itures ($) *****	Funds Expended to date: Total Spent to date ($)	Admin-istrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechan-ism
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-031 Port of Long Beach Microgrid - Resilience for Critical Facilities	Technology Demonstration and Deployment	This project will create a microgrid at the Port's critical response facility, the Joint Command and Control Center (JCCC). Key features include photovoltaic energy production, stationary battery energy storage, mobile battery energy storage, and a microgrid controller. Both batteries will provide grid services, such as demand response and peak shaving, during regular operation of the utility grid. During wide-spread outages or emergencies, the microgrid will support the Joint Command and Control Center, which coordinates response to emergencies. The mobile battery will act to extend the microgrid as a zero-emission generator that can be deployed where needed, such as stormwater pump stations and refrigerated container yards.	3/21/2018	No	Distribution	$5,000,000	$5,000,000	$116,951	N/A	$116,951	$95,909	$0	Electric Power Research Institute, Inc.; National Renewable Energy Laboratory; Advanced Power and Energy Program (APEP) - University of California, Irvine; City of Long Beach, Harbor Department (Port of Long Beach); Schneider Electric Buildings Americas, Inc.; South Orange County Community College District	$2,120,000	29.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-032 Miramar Microgrid - Flight Line Resilience through Landfill Gas and Energy Storage	Technology Demonstration and Deployment	This project will demonstrate a microgrid at Marine Corps Air Station Miramar. It will incorporate distributed energy resources including: bio gas generators, solar PV, battery energy storage, and electric vehicles. When operational, the microgrid will help maintain critical flight line facilities during grid outages and facilitate higher renewable generation from landfill gas (LFG) generators.	3/21/2018	No	Demand-side Management	$5,000,000	$5,000,000	$86,615	N/A	$86,615	$425,962	$20,000,000	Marine Corps Air Station Miramar	$6,002,320	54.6%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-033 Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience	Applied Research and Development	This project builds on the Cal-Adapt platform to provide enhanced tools, data services, and visualizations that leverage existing web infrastructure and features to improve usability to energy sector stakeholders. The research team will collaborate closely with the Energy Commission and energy stakeholders, including IOUs and the California Independent System Operator, to build on Cal-Adapt, developing enhanced targeted visualizations and tools that allow for improved decision support that leverages projections of parameters associated with climate-related risk. Priority tools will address sea level rise and wildfire. These new tools are being designed in close coordination with stakeholders, as the requirements of each organization necessitate tools that are specific to their application needs. Targeted visualization tools depict climate-related risks from a variety of stressors on electricity infrastructure, enabling improved planning for future reliability.	3/21/2018	No	Grid Operations/ Market Design	$900,000	$900,000	$385,786	N/A	$385,786	$172,916	$0	None	$0	0.0%	Grant

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EPC-17-031 Port of Long Beach Microgrid - Resilience for Critical Facilities	Pre-existing intellectual property identified in agreement EPC-17-031 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	City of Long Beach, Harbor Department (Port of Long Beach)	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The project has several innovations, including the ability to allow for direct DC transfer of energy from the PV system to the battery, significantly improving the efficiency of the stored energy, and testing charge and discharge strategies for the mobile battery to support load reduction during normal operations and providing support power to various distributed critical loads in an emergency.	1b, 1c, 1h, 4a, 5b	Thirty percent of the microgrid design has been reviewed and approved following multiple system design iterations for addressing site constraints. A workforce development study has begun that will identify the workforce needs for supporting a microgrid. The outputs of the study will be used by a community college to develop microgrid training packages. Initial cyber-security development work has explored various system configurations to address operational user needs, real-time system communication requirements, and protective features. Learnings from this preliminary cyber security work have highlighted the complexity of microgrid systems integration and operational communications. The Port of Long Beach Microgrid won an award from *Power Magazine* in July 2019.
EPC-17-032 Miramar Microgrid - Flight Line Resilience through Landfill Gas and Energy Storage	Pre-existing intellectual property identified in agreement EPC-17-032 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	The Regents of the University of California, San Diego	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity	This project is incorporating a large scale battery storage system, as well as advanced demand response controls, into a very complex microgrid with a heavy penetration of renewables and over 100 buildings worth of load. Energy storage will allow the microgrid to incorporate higher penetrations of renewable landfill power in island mode, while mitigating demand charges in economic mode, saving money for the Base. This project will address critical challenges associated with instantaneous power loss from the bio gas generators by using microgrid controlled distributed energy resources. Furthermore, project findings will be relevant to landfill gas generation facilities, wastewater treatment plants with biogas generation, as well as hospitals, ports, and military bases.	2a, 3h, 4b, 5a	In 2019, the project team analyzed cost estimates for different battery power and energy combinations to help identify Miramar's energy storage requirements (1.9MW/2MWh) and selected Schneider Electric as the battery vendor. The team completed the microgrid design report, which analyzes load and generation data to assess outage frequency and duration and outlines microgrid use cases for reliability and economics. In terms of design, the team developed engineering drawings for the battery energy system and microgrid controller to 60% completion.
EPC-17-033 Building on the Cal-Adapt Platform to Deliver Actionable Information in Support of Electricity Sector Resilience	Pre-existing intellectual property identified in agreement EPC-17-033 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Berkeley	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project is providing needed actionable information to energy sector stakeholders regarding climate change consequences on electricity generation and distribution. California's energy system is facing, and will continue to contend with, a changing climate. Substantial changes in the climate are projected to occur within a timeframe that overlaps with the time horizons of a variety of electricity system planning decisions, such as siting of power generation facilities and transmission lines. Regionally downscaled climate projections with high spatial resolution are valuable resources to better plan electricity and energy infrastructure developments, adaptations, and future siting.	3a, 5c	The project has developed and released a Data Download Tool, making it possible for users to discover and access climate data for California from the state's scientific and research community hosted on Cal-Adapt. The researchers have also developed a public API for programmatically accessing climate data hosted on Cal-Adapt, making it easier to build data-driven applications and analyses. The API allows users to access only the data they actually need, without having to download the entire dataset. These tools were developed with input from Technical Advisory Committee members, from meetings with electricity IOUs, and from users via webinars. The research also took steps to develop an enhanced Wildfire Tool and an Enhanced Sea Level Rise Tool.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-034 California Energy Product Evaluation Hub	Market Facilitation	This project will develop the California Energy Product Evaluation (Cal-EPE) Hub to conduct and disseminate evaluations of advanced DER products relevant to large commercial and institutional customers through a web-based buyer's guide. To accomplish this, the recipient will: (1) determine Cal-EPE Hub user (i.e. large commercial and institutional customers) needs; (2) develop a list of product categories to evaluate based on user needs; (3) develop evaluation guidelines and methodologies; (4) acquire (through purchase or donation) and evaluate products from product categories; and (5) develop a web-based Buyer's Guide, which will contain the results of product evaluations and related information and documentation.	3/21/2018	No	Demand-side Management	$10,993,646	$10,993,646	$180,977	N/A	$180,977	$3,915,128	$0	Center for the Built Environment - UC Berkeley; Western Cooling Efficiency Center - UC Davis; Sheet Metal Workers 104 & Bay Area Industry Training Fund; Collaborative for High Performance Schools; Lawrence Berkeley National Laboratory; Local Government Commission; Cohen Ventures Inc. dba Energy Solutions	$2,347,629	17.6%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-035 Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley	Applied Research and Development	This project develops a holistic community action plan to achieve climate benefits and air quality improvements through energy efficiency measures, electrification, and distributed energy resources in the residential building and light-duty and medium-duty transportation sectors in the City of Fresno. Field surveys and validation testing provide inputs on appropriate implementation strategies and selection of systems and technologies to overcome barriers associated with site characteristics and user responses. Researchers monitor energy use and air quality in typical households within disadvantaged communities to inform analysis of energy programs.	4/11/2018	No	Distribution	$1,100,000	$1,100,000	$454,691	N/A	$454,691	$401,103	$1,000,000	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-038 Camp Parks Army Microgrid - A Blueprint for Nested, Modular Design	Technology Demonstration and Deployment	The Parks Reserve Forces Training Area (PRFTA) microgrid project will produce a permanent, modular, nested design that maximizes renewables and is inherently secure, expandable, economically viable and efficient. The project will deliver a blueprint for incorporating multiple distributed energy resources (DER); a vendor-neutral microgrid control system; and a resilient nodal building block approach that supports grid-within-grid nesting. The project will also develop engineering guidelines and an easy-to-adapt "how-to" case tool for accelerated adoption and commercialization.	3/21/2018	No	Demand-side Management	$5,000,000	$5,000,000	$1,649,032	N/A	$1,649,032	$817,221	$0	Customized Energy Solutions; Ultrasolar Technology; U.S. Army	$11,410,900	69.5%	Grant

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EPC-17-034 California Energy Product Evaluation Hub	Pre-existing intellectual property identified in agreement EPC-17-034 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	Western Cooling Efficiency Center - UC Davis	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The California Energy Product Evaluation (Cal-EPE) Hub will increase the adoption of advanced DER technology products in the marketplace by disseminating reliable and independent product evaluations to large commercial and institutional customers, through a web-based buyer's guide, which will help these customers more confidently select the DER technology they require with their procurement process.	1c, 1f, 1h, 2a, 3b, 3e, 3h, 4a	The recipient has completed the following in 2019: Completed interviews and surveys with target customers and used these findings to complete and prioritize the list of product categories for Phase 1 and 2 testing. Compiled a list of Product Advisory Group (PAG) members, per product category. Held PAG meetings and used feedback to finalize product evaluation guidelines and the list of specific products (i.e. models) that will be tested in Phase 1. Completed the Hub Website Development and Outreach Guide, and Buyers Guide Outline, describing the planned content that will be included on the hub website. In early 2020, the recipient will focus on the following: completing final test protocols and procedures for Phase 1 product category testing, preparing and starting Phase 1 evaluations, preparing PAG member lists for Phase 2 evaluations.
EPC-17-035 Building Healthier and More Energy-Efficient Communities in Fresno and the Central Valley	Pre-existing intellectual property identified in agreement EPC-17-035 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Lawrence Berkeley National Laboratory	Group 2b: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project provides state-of-the-art information and analyses on the impacts of prioritized and integrated energy efficiency, electrification, distributed energy resources, and battery electric vehicles in the Fresno area in relation to climate benefits and air quality improvements.	1f, 2a, 4b	The first community workshop was held in August 2019 at Columbia Elementary School in Fresno, CA. The workshop facilitated input on energy survey topics and questions. Energy surveys were conducted in designated project communities. The research team has also compiled building data from publicly available sources, and the neighborhood-scale City-BES modeling tool (CityBES.lbl.gov) has been updated to include building data for south Fresno neighborhoods of interest. Data includes building vintages and floor sizes for all residential buildings.
EPC-17-038 Camp Parks Army Microgrid - A Blueprint for Nested, Modular Design	Pre-existing intellectual property identified in agreement EPC-17-038 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Lawrence Berkeley National Laboratory	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project will demonstrate how a nested set of smaller microgrids within an overall base microgrid can be designed and operated to provide resilience on the base, while substantially reducing energy use and the need for multiple backup diesel generators. This approach can be transferrable to other military bases or similar commercial or academic campuses or local communities to improve resilience.	1h, 2a, 3h, 5a	In 2019, the project team completed the microgrid design for the army base, and held the first technical advisory committee and critical project review meetings. All subcontracts have been signed and are in place. The $11 million cost-share from the Department of Defense for this project has been secured.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-039 DER-VET A Distributed Energy Resource Value Estimation Tool	Applied Research and Development	This project will develop the Distributed Energy Resource Value Estimation Tool (DER-VET), a publicly-available, open-source, microgrid valuation, and optimization software tool to aid in the design of microgrid and distributed energy resource deployments.	5/9/2018	No	Distribution	$2,000,000	$2,000,000	$238,258	N/A	$238,258	$479,496	$0	Electric Power Research Institute, Inc.; XENDEE	$568,110	22.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-040 ** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	Technology Demonstration and Deployment	This project develops and demonstrates standardized energy efficiency retrofit packages, specifically geared towards the low-income multifamily housing market, and that can be scaled to drive down costs. As part of the agreement, the recipient will develop a business model for these packages to overcome financing challenges.	6/13/2018	No	Demand-side Management	$4,802,872	$4,802,872	$181,018	N/A	$181,018	$1,555,647	$6,200,000	Association for Energy Affordability; Rocky Mountain Institute; Stone Energy Associates; City of San Francisco Department of Environment	$6,705,308	48.2%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-040 ** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	Applied Research and Development	This project develops and demonstrates standardized energy efficiency retrofit packages, specifically geared towards the low-income multifamily housing market, and that can be scaled to drive down costs. As part of the agreement, the recipient will develop a business model for these packages to overcome financing challenges.	6/13/2018	No	Demand-side Management	$2,401,436	$2,401,436	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant

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EPC-17-039 DER-VET A Distributed Energy Resource Value Estimation Tool	Pre-existing intellectual property identified in agreement EPC-17-039 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 1	N/A	N/A	No	This agreement will lead to technological advancement and breakthroughs by developing a new tool for microgrid development for utilities and developers that will evaluate how the DER and microgrid systems can be optimized for sizing, owner benefits, and tool as a flexible grid resources.	1b, 1c, 1f, 1h, 5b, 5f	In 2019, the EPRI team tested and released the alpha version of DER-VET. EPRI is also improving the tool based on the feedback received from internal and external users. EPRI is finalizing the prototype and the wireframe of the graphic user interface to enhance the efficiency and ease of use for the end-users. EPRI will release the beta version in early 2020.
EPC-17-040 ** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	Pre-existing intellectual property identified in agreement EPC-17-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Rocky Mountain Institute	Group 3: Ranked # 1	N/A	N/A	No	Significant improvements in speed and cost reductions of retrofit packages are critical to realizing mass-scale deployment of retrofits. Even when pairing grants from the State's Low-Income Weatherization Program (LIWP) for multifamily buildings, it is rare that those retrofit projects alone can achieve ZNE. The key to bringing costs down and construction speeds up is to simultaneously address the technical and business model barriers that exist in the market. Some of the innovative approaches to be considered include: modularized, pre-fabricated, pre-insulated building enclosures; packaged multi-function heat pumps for heating and cooling; energy recovery ventilation; advanced heat pump water heaters; and behavior modification technologies and strategies. These approaches hope to speed up implementation, bring down retrofit costs, and integrate them into programs, such as LIWP.	1f, 2a, 3a, 3b, 3f	In 2019, Rocky Mountain Institute, formerly one of the subs, became the prime, and Prospect Silicon Valley, formerly the prime, became a subcontractor. As a result of this change, two teams were created: the technical team and the market solutions team. The technical team is working on an Emerging Technologies Assessment Criteria which outlines how technologies will be evaluated and also on evaluating the current multifamily building stock in California to identify ideal types of buildings for the proposed retrofit approach. The market solutions team is working on identifying and overcoming market barriers for wide-scale deployment of retrofits for multifamily buildings. Rocky Mountain Institute has submitted a proposal to a Department of Energy (DOE) funding opportunity and if awarded will leverage DOE funds to help the development of the CEC project.
EPC-17-040 ** Mass Deployment of Energy Efficiency Retrofits in Disadvantaged Communities	Pre-existing intellectual property identified in agreement EPC-17-040 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Rocky Mountain Institute	Group 3: Ranked # 1	N/A	N/A	No	Significant improvements in speed and cost reductions of retrofit packages are critical to realizing mass-scale deployment of retrofits. Even when pairing grants from the State's Low-Income Weatherization Program (LIWP) for multifamily buildings, it is rare that those retrofit projects alone can achieve ZNE. The key to bringing costs down and construction speeds up is to simultaneously address the technical and business model barriers that exist in the market. Some of the innovative approaches to be considered include: modularized, pre-fabricated, pre-insulated building enclosures; packaged multi-function heat pumps for heating and cooling; energy recovery ventilation; advanced heat pump water heaters; and behavior modification technologies and strategies. These approaches hope to speed up implementation, bring down retrofit costs, and integrate them into programs, such as LIWP.	1f, 2a, 3a, 3b, 3f	In 2019, Rocky Mountain Institute, formerly one of the subs, became the prime, and Prospect Silicon Valley, formerly the prime, became a subcontractor. As a result of this change, two teams were created: the technical team and the market solutions team. The technical team is working on an Emerging Technologies Assessment Criteria which outlines how technologies will be evaluated and also on evaluating the current multifamily building stock in California to identify ideal types of buildings for the proposed retrofit approach. The market solutions team is working on identifying and overcoming market barriers for wide-scale deployment of retrofits for multifamily buildings. Rocky Mountain Institute has submitted a proposal to a Department of Energy (DOE) funding opportunity and if awarded will leverage DOE funds to help the development of the CEC project.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-041 ** Lead Locally	Technology Demonstration and Deployment	This project is evaluating and demonstrating strategies to increase retrofits of existing buildings and includes the following elements: 1) identification and pilot testing of promising emerging efficiency technology packages for cost-effectiveness, feasibility, and customer acceptance; 2) development of an "Energy Marketplace" where consumers can directly procure technologies appropriate for their buildings. This will be combined with financing and rebates. The program targets those with little to no upfront capital and are the most difficult to reach. Training will be offered to contractors, realtors, and building officials with the goal of greatly increasing customer knowledge, decreasing code violations, and increasing penetration of energy efficiency measures outside the framework of utility programs.	4/11/2018	No	Demand-side Management	$6,543,064	$6,543,064	$1,842,821	N/A	$1,842,821	$4,687,705	$0	Sonoma Clean Power Authority	$3,335,500	25.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-041 ** Lead Locally	Applied Research and Development	This project is evaluating and demonstrating strategies to increase retrofits of existing buildings and includes the following elements: 1) identification and pilot testing of promising emerging efficiency technology packages for cost-effectiveness, feasibility, and customer acceptance; 2) development of an "Energy Marketplace" where consumers can directly procure technologies appropriate for their buildings. This will be combined with financing and rebates. The program targets those with little to no upfront capital and are the most difficult to reach. Training will be offered to contractors, realtors, and building officials with the goal of greatly increasing customer knowledge, decreasing code violations, and increasing penetration of energy efficiency measures outside the framework of utility programs.	4/11/2018	No	Demand-side Management	$3,271,532	$3,271,532	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-17-042 *** Camptonville Biomass-to-Energy Project	Technology Demonstration and Deployment	The project will demonstrate an innovative 5.5 MW biomass power plant located in Camptonville, California that will: • Produce a replicable power plant design that can help reduce costs for future plants, and accelerate adoption of comparable capacity biomass plants at other California locations • Demonstrate a robust direct combustion technology that has the flexibility to utilize diverse biomass feedstock available throughout California Validate significant reductions in NOx, CO, and VOC emissions, and • Reduce water consumption required for biomass power generation • Increase availability of renewable electricity and grid reliability while reducing emissions and wildfire threats.	10/3/2018	No	Generation	$4,999,830	$4,999,830	$0	N/A	$0	$110,031	$0	Phoenix Energy	$13,030,225	72.3%	Grant

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EPC-17-041 ** Lead Locally	Pre-existing intellectual property identified in agreement EPC-17-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Sonoma Clean Power Authority	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project could increase market penetration for existing building retrofits and result in deeper savings per site using the existing program funding that Sonoma Clean Power and the investor-owned utilities will allocate in future years. The project anticipates providing a full range of options for customers--from whole building integrated retrofits to partial retrofits and traditional equipment upgrades, depending on the customer's interest, budget, and need. The high level estimated net present value of the project benefits is over $60M in 2030. Additional benefits could be realized if fuel-switching strategies that are being evaluated as part of the applied research phase of the project meet cost-effectiveness, feasibility, and customer acceptance criteria and can be included in the Energy Marketplace.	1f, 1h	The recipient has submitted a set of interim reports on project evaluation, measurement and verification (EM&V) frameworks. These reports summarize the team's detailed plans for instrumentation, monitoring, and EM&V process for each technology demonstration considered under this project. The demonstration enrollments and installations, and performance measurements for these technologies will be conducted through Q1 2021. The renovations for the Energy Marketplace is delayed and the grand opening is expected to be around Q2 2020. The project was featured at the 2019 ACEEE Hot Water Forum, and the CPUC-CEC Joint Agency Workshop on Building Decarbonization on 4/8/19. The official website of the program can be found at sonomacleanpower.org/lead-locally.
EPC-17-041 ** Lead Locally	Pre-existing intellectual property identified in agreement EPC-17-041 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	Sonoma Clean Power Authority	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project could increase market penetration for existing building retrofits and result in deeper savings per site using the existing program funding that Sonoma Clean Power and the investor-owned utilities will allocate in future years. The project anticipates providing a full range of options for customers--from whole building integrated retrofits to partial retrofits and traditional equipment upgrades, depending on the customer's interest, budget, and need. The high level estimated net present value of the project benefits is over $60M in 2030. Additional benefits could be realized if fuel-switching strategies that are being evaluated as part of the applied research phase of the project meet cost-effectiveness, feasibility, and customer acceptance criteria and can be included in the Energy Marketplace.	1f, 1h	The recipient has submitted a set of interim reports on project evaluation, measurement and verification (EM&V) frameworks. These reports summarize the team's detailed plans for instrumentation, monitoring, and EM&V process for each technology demonstration considered under this project. The demonstration enrollments and installations, and performance measurements for these technologies will be conducted through Q1 2021. The renovations for the Energy Marketplace is delayed and the grand opening is expected to be around Q2 2020. The project was featured at the 2019 ACEEE Hot Water Forum, and the CPUC-CEC Joint Agency Workshop on Building Decarbonization on 4/8/19. The official website of the program can be found at sonomacleanpower.org/lead-locally.
EPC-17-042 *** Camptonville Biomass-to-Energy Project	Pre-existing intellectual property identified in agreement EPC-17-042 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	phase 1: 56 out of 57 bidders; phase 2: 23 out of 23 bidders	Camptonville Community Partnership, Inc	Ranked # 4	N/A	N/A	No	The plant's key technologies have been successfully used as individual components, but they have not been demonstrated as an integrated system at the relatively small scale (5 MW net) intended for this project. The innovation for this project is to design and build a 5.5 MW forest biomass-to-electricity power plant using an advanced emissions control and low water use condenser. The facility is estimated to consume 50,000 bone dry tons of woody biomass annually, which will be derived from dead and diseased trees and forest byproducts harvested from public and private forested lands near Camptonville, California.	1a, 1b, 1c, 2a	The project was initially approved the October 2018 Business Meeting and again at the January 22, 2020 Business Meeting because of project revisions. This most recent approval was to change the prime grant recipient to Camptonville Community Partnership after the original prime recipient and a major subcontractor withdrew from the project. Otherwise, the project itself, the Camptonville Biomass-to-Energy Project (aka Forest Biomass Business Center Bioenergy Facility - Gellerman Site), including the scope, has not changed. The agreement execution is in process and anticipated to be completed before the end of February 2020.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-043 GLOW: A User-friendly Interface for GridLAB-D	Applied Research and Development	This project is developing GridLAB-D Open Workspace (GLOW), an intuitive interface for GridLAB-D that will provide a user-friendly environment for researchers, planners, developers, and regulators involved in advanced electric grid technology simulation and scenario analysis. The interface will simplify data input and simulations, enable visualization of complex information, and be scalable for big data simulations. GLOW will be a freely available and widely supported open-source tool based on existing GridLAB-D technology.	5/9/2018	No	Distribution	$2,999,699	$2,999,699	$1,168,828	N/A	$1,168,828	$193,906	$0	Hitachi America LTD; National Grid	$1,255,060	29.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-044 ** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	Technology Demonstration and Deployment	The project objective is to develop a web-based marketplace platform for connecting customers with energy service providers, technologies, and lenders; installing retrofits at a variety of commercial customer sites in southern California, evaluating the pay-for-performance concept. This includes financing components to offset customer costs, insurance markets to reduce perceived risk for lenders, and a sales-as-a-service marketplace where efficiency products and services are connected with sales professionals.	6/13/2018	No	Demand-side Management	$4,799,543	$4,799,543	$578,247	N/A	$578,247	$2,139,730	$0	InTech Energy, Inc.	$2,600,274	26.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-044 ** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	Applied Research and Development	The project objective is to develop a web-based marketplace platform for connecting customers with energy service providers, technologies, and lenders; installing retrofits at a variety of commercial customer sites in southern California, evaluating the pay-for-performance concept. This includes financing components to offset customer costs, insurance markets to reduce perceived risk for lenders, and a sales-as-a-service marketplace where efficiency products and services are connected with sales professionals.	6/13/2018	No	Demand-side Management	$2,399,772	$2,399,772	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant

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EPC-17-043 GLOW: A User-friendly Interface for GridLAB-D	Pre-existing intellectual property identified in agreement EPC-17-043 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	Hitachi America LTD	Group 4: Ranked # 1	N/A	N/A	No	The technical advancement of the project is the development of an intuitive and widely available user interface for GridLAB-D, a software simulation tool for advanced distribution system simulation and analysis developed by the U.S. Department of Energy.	3b, 3c, 5b	In 2019, the project team completed their specifications for GLOW and has started working on the graphical user interface development. They showcased what they have developed so far and are working with investor owned utilities under a nondisclosure agreement to help confirm and validate the integrated capacity analysis. Once validated, the use case will provide a skeleton to branch to other use case scenarios including but not limited to: tariff design, grid resilience, and distribute energy resource growth scenarios.
EPC-17-044 ** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	Pre-existing intellectual property identified in agreement EPC-17-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	InTech Energy, Inc.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project hopes to accelerate the adoption of market-driven, pay-for-performance retrofits at commercial customer sites by maximizing market potential using Sales-as-a-Service marketplace where customers, products and supporting services can connect with industry professionals. Through this marketplace, the value of energy efficiency will be standardized and transparent, lowering cost and time to implement these technologies. The combination of these methods, along with new energy efficiency technologies in the demonstration sites, will showcase how cost-effective, energy-efficient solutions can be provided in a timely fashion.	1e, 1f, 1h	This project is currently on hold pending a review of the project objective and scope.
EPC-17-044 ** Researching, Developing, Demonstrating the Commoditization of Building Energy Efficiency Retrofits in Southern California	Pre-existing intellectual property identified in agreement EPC-17-044 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	18 out of 18 bidders	InTech Energy, Inc.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project hopes to accelerate the adoption of market-driven, pay-for-performance retrofits at commercial customer sites by maximizing market potential using Sales-as-a-Service marketplace where customers, products and supporting services can connect with industry professionals. Through this marketplace, the value of energy efficiency will be standardized and transparent, lowering cost and time to implement these technologies. The combination of these methods, along with new energy efficiency technologies in the demonstration sites, will showcase how cost-effective, energy-efficient solutions can be provided in a timely fashion.	1e, 1f, 1h	This project is currently on hold pending a review of the project objective and scope.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-045 Oak View Microgrid: Using Microgrid Technologies to Simultaneously Improve Quality of Life and Electric Grid Operations	Applied Research and Development	This project develops multiple urban energy scenarios (UES) in which multiple types of energy efficiency, electrification, and microgrid technologies are considered. The design approach uses integrated methods that simultaneously consider various technology and retrofit options, while also verifying that the proposed technology mixes accomplish the goals of improving air quality and grid operations. The work will result in the proposal of a microgrid design ready for implementation in Oak View and an extensible and robust design methodology that can be used throughout the state for economic and environmentally sensitive microgrid development.	4/11/2018	No	Grid Operations/ Market Design	$1,099,760	$1,099,760	$151,139	N/A	$151,139	$157,594	$0	County of Orange/City of Huntington Beach; National Renewable Energy Laboratory (NREL); Altura Associates, Inc.; ComUNIDAD	$367,804	25.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-046 HiPAS GridLAB-D: A High-Performance Agent-based Simulation using GridLAB-D	Applied Research and Development	The High Performance Agent-Based Simulation (HiPAS) GridLAB-D project will increase the performance of the open-source version of GridLAB-D and improve the broad accessibility of high-performance power grid simulation capabilities to the community of smart grid and distribution simulation users in California. HiPAS includes methods that parallelize many of the iterative methods used in simulations. HiPAS is intended for both desktop multi-core processors and cloud platforms. It will enable GridLAB-D users to more efficiently analyze multiple scenarios with improved resolution by reducing the computational costs associated with analysis.	5/9/2018	No	Grid Operations/ Market Design	$3,068,781	$3,068,781	$1,976,439	N/A	$1,976,439	$1,149,270	$6,730,000	National Grid	$300,000	8.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-047 OpenFIDO: An Open-source Framework for Integrated Data Operations	Applied Research and Development	This project will develop OpenFIDO, an open source tool to transfer data between various programs that are part of the suite of tools used in by utilities, distributed energy resource (DER) engineers and regulators in California. The tool is an integration framework to quickly move data from one application to another as part of their engineering, planning, and review activities.	5/9/2018	No	Distribution	$1,000,000	$1,000,000	$606,989	N/A	$606,989	$367,282	$0	National Grid	$30,000	2.9%	Grant

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EPC-17-045 Oak View Microgrid: Using Microgrid Technologies to Simultaneously Improve Quality of Life and Electric Grid Operations	Pre-existing intellectual property identified in agreement EPC-17-045 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Irvine	Group 2a: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project is advancing the integration of emerging and proven sustainable energy technologies with various end uses in the Oak View community, helping to facilitate the implementation of SB 535 and AB 1550 that require maximizing benefits from low-carbon technologies to disadvantaged communities. For the first time, this study is assessing ways to reduce particulate matter, nitrogen oxides, and other indoor and outdoor air pollutants associated with appliances used in homes and with electricity generated and served to the subject community. The research team is using big data to develop decarbonization pathways for the community energy system that will include increased energy efficiency improvements within existing residential buildings, renewable energy generation and energy storage technologies, vehicle electrification, and electrification of natural gas appliances.	1f, 1h, 2a, 4a, 4b	The research team has been developing an optimization software tool, known as DERopt, which models distribution system operations and helps users select an optimal mix of energy efficiency, electrification, and microgrid technologies for a given community to achieve its desired outcomes. The team will use this tool and additional methodologies to develop the UES for consideration in the project. The team has also been collecting "big data" about the built environment and energy consumption behavior in the Oakview community. The researchers described the types of data collected in the Built Environment and Energy Consumption Report; they include the current building stock, building vintage, building end use, electrical and natural gas energy use, and the mapping of local energy utility infrastructure.
EPC-17-046 HiPAS GridLAB-D: A High-Performance Agent-based Simulation using GridLAB-D	Pre-existing intellectual property identified in agreement EPC-17-046 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	SLAC National Accelerator Laboratory	Group 3: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The project will achieve technology advancement and usability breakthroughs in the following performance areas: 1) Granular object-level parallelization of computations; 2) Large-scale parametric job control; 3) Sensitivity analysis; and 4) Monte Carlo analysis. These advancements will improve the accessibility and applicability of GridLAB-D to California utilities, government agencies, and researchers who are responsible for system policy, planning, operation and oversight in the presence of growing customer-based demand response and renewable energy resources.	1a, 1b, 3a, 5b	In 2019, the project team developed the requirements and design for the HiPAS project. They worked on implementing these requirements and updating modules with more accurate and granular capabilities including commercial and residential buildings, markets, database, and power flows. They also supported core system development, workflow and format support requirements for two other EPIC funded modeling projects: GLOW and OpenFIDO. As for accelerating simulations, they are looking into machine learning to bypass unneeded computations.
EPC-17-047 OpenFIDO: An Open-source Framework for Integrated Data Operations	Pre-existing intellectual property identified in agreement EPC-17-047 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	SLAC National Accelerator Laboratory	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Current grid simulation tools do not support the exchange of data to other programs. This is not sufficient when many different tools are used to analyze the many multi-disciplinary problems energy system researchers, analysts and regulators must address. OpenFIDO proposes to use an open multi-standard approach to data exchange called polyglot representation. This approach allows data to be exchanged so that data sets of commercial buildings, retail tariffs, and distribution networks can be reliably exchanged between the various distribution system analysis and simulation tools that are currently used. This enables better analysis of the impacts of DERs in distribution planning.	1b, 1c, 5a, 5b	In 2019, the project team completed the design for the data exchange tool. The project team also conducted a workshop and TAC meeting in September 2019. The project team presented updates on data imports and requirements documentation. Attendance at both the workshop and meeting, included representatives from CPUC, PG&E, SCE, PNNL, SunRun, Kevala, and National Grid. Attendees provided a large amount of feedback regarding the various needs and applications for OpenFIDO. Possible applications included integrated capacity analysis, tariff designs, and electrification.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-048 Engaging Communities in the Design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley	Applied Research and Development	Through the analysis of "big data" comprising remotely-sensed images (e.g. agriculture lands, road networks, and built environment) and Geographic Information System (GIS) layers (e.g. energy consumption, distribution networks, new build construction, reserve areas, and planning documents), the project team is developing an analysis that examines specific dense urban areas with both high potential for retrofits that can help meet the needs of disadvantaged communities. Through the identification of critical "Urban-Agriculture Interface Zones" using a GIS-based hot spot analysis across the Southern San Joaquin Valley, the project identifies and engages with communities (with community-based organizations) to conduct SELF modeling. This project identifies opportunities in the SELF communities for efficiency and energy system improvements based on analysis of energy optimization tools such as the Solar, Wind, Investment in Technology, Hydropower (SWITCH) model. An optimization model is being developed for these densely populated zones to design "SELF- SWITCH" systems (SELF-SWITCH model).	4/11/2018	No	Grid Operations/ Market Design	$1,100,000	$1,100,000	$53,161	N/A	$53,161	$228,397	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-049 Port of San Diego Microgrid - Resiliency in Terminal Operations	Technology Demonstration and Deployment	The project will develop a new, permanent, renewable microgrid at the Tenth Avenue Marine Terminal that can be replicated at other seaport terminals and distribution facilities throughout California, the U.S., and internationally. The project will incorporate solar photovoltaic renewable generation, battery energy storage, energy efficiency improvements, and a centralized microgrid controller to allow key elements of the terminal to remain operational when islanded from the electrical grid for a minimum of 12 hours. The proposed microgrid will test the integration of four distributed energy resources.	5/9/2018	No	Distribution	$4,985,272	$4,985,272	$0	N/A	$0	$422,043	$0	The Regents of the University of California, San Diego; San Diego Unified Port District (Port of San Diego)	$4,629,936	48.2%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-050 Using Big Data to Holistically Assess Benefits from Building Energy System Transition Pathways in Disadvantaged Communities	Applied Research and Development	This research project supports holistic urban energy planning for the Avocado Heights community that simultaneously considers urban renewables, indoor and outdoor air quality, deep energy efficiency options, retrofitting of homes and buildings, electrification, and issues of environmental justice.	7/11/2018	No	Distribution	$1,098,662	$1,098,662	$56,773	N/A	$56,773	$233,968	$0	Regents of the University of California, Los Angeles	$54,740	4.7%	Grant

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EPC-17-048 Engaging Communities in the Design of Sustainable Energy and Localized Futures (SELF) Models in California's San Joaquin Valley	Pre-existing intellectual property identified in agreement EPC-17-048 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Berkeley	Group 2b: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This research is advancing the state of the art by developing a new model that can explore the cost and feasibility of generation, transmission, and storage options for the future electricity system in a sub-regional environment. The model identifies cost-effective investment decisions for meeting electricity demand, taking into account the existing grid as well as projections of future technological developments, renewable energy potential, fuel costs, and public policy. Integrating this model with updated GIS and geographically relevant data and algorithms for a sub-regional development will assist California's energy system planners.	3a	The research team has developed an initial review of relevant models relating to energy systems and land use including a review of open-source modeling platforms and applications. The research team has also developed a draft ("beta") SELF Github site that will provide open and available data for the SELF project, including: 1) GIS Enviroscreen data layers; 2) Tiger Shapefiles and boundary layers; 3) road and infrastructure network layers; 4) land use and designated places layers; 5) San Joaquin Valley unincorporated communities and estimated population layers; 6) infrared radiometer data layers; and 7) draft Rscript for running calculations on existing data. The team continues to develop a framework to guide surveys and other inputs for informing the GIS and modeling processes.
EPC-17-049 Port of San Diego Microgrid - Resiliency in Terminal Operations	Pre-existing intellectual property identified in agreement EPC-17-049 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	San Diego Unified Port District (Port of San Diego)	Group 1: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	The project will develop a solar-powered, resilient microgrid that will provide power to critical loads and allow key elements of the terminal to remain operational for 12 hours or longer when islanded from the grid.	1b, 1c, 1h, 4a, 5b	The Port has achieved advanced stages of microgrid system design, developed bid documents and initiated a best value public procurement process for the microgrid systems. Key learnings include challenges associated with evaluating microgrid whole of life project costs under a public procurement process. In parallel, the Port has begun warehouse roof replacement work to support the solar PV array installation, as well as energy efficient lighting installation work.
EPC-17-050 Using Big Data to Holistically Assess Benefits from Building Energy System Transition Pathways in Disadvantaged Communities	Pre-existing intellectual property identified in agreement EPC-17-050 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 29 bidders	The Regents of the University of California, Los Angeles	Group 2a: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Energy planning is often conducted in a piecemeal fashion, focusing on opportunities relevant to individual market sectors or fuels. This project is taking a different approach, using a holistic approach for urban energy planning with the final goal of identifying economically attractive options for deep GHG reductions and improved environmental conditions in Avocado Heights.	4a, 4b	The recipient has assembled a multi-disciplinary research team that has expertise spanning public health, energy engineering, and public engagement. The research is being carried out in close collaboration with community-based representatives; this allows the research team to elicit community perspectives and effectively integrate community objectives. The research team has conducted two field studies measuring ambient air quality conditions.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-051 LEED: A Lightwave Energy-Efficient Datacenter	Applied Research and Development	The goal of this federal cost share grant, the Lightwave Energy-Efficiency Datacenter (LEED) program, is to at least double the current energy efficiency of a datacenter. This dramatic improvement is realized by increasing the energy utilization of each server by means of a novel lightwave network. The LEED network can substantially increase the network bandwidth which leads to a corresponding improvement in the server energy utilization. This improvement can be realized at a cost comparable to a state-of-the-art datacenter network based on conventional electrical switching technologies.	5/9/2018	No	Demand-side Management	$475,000	$475,000	$412,178	N/A	$412,178	$78,440	$4,643,524	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-052 Urban Microgrids for Grid Resiliency and Disaster Readiness	Technology Demonstration and Deployment	EPC-17-052	5/9/2018	No	Distribution	$4,995,498	$4,995,498	$323,976	N/A	$323,976	$562,214	$0	Electric Power Research Institute, Inc.; InTech Energy, Inc.; Gridscape Solutions, Inc.; TRC Energy Services	$3,281,992	39.6%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-053 Santa Rosa Junior College Urban Microgrid Project	Technology Demonstration and Deployment	Santa Rosa Junior College (SRJC) will demonstrate a microgrid on campus. This project will integrate three types of distributed energy resource (DER) elements: solar photovoltaic (PV) generation, energy storage, and load reduction devices and load control systems, all managed by a single microgrid controller. The goals of this project are to meet 40% of the campus electricity requirement with emissions-free PV solar power, to reduce the campus peak load, to optimize energy use, to provide support services to the surrounding grid, and to create a highly resilient power system benefitting the campus and the community. This project will demonstrate the environmental, economic, and resiliency benefits of a highly flexible campus microgrid. Operational objectives encompass demonstration of power flow, load control, and energy storage in a large multi-building campus, operating at appropriate scale and in actual operating conditions.	6/13/2018	No	Demand-side Management	$4,999,005	$4,999,005	$0	N/A	$0	$348,244	$0	SunPower Corporation, Systems; Sonoma County Junior College District/ Santa Rosa Junior College	$8,689,759	63.5%	Grant

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EPC-17-051 LEED: A Lightwave Energy-Efficient Datacenter	Pre-existing intellectual property identified in agreement EPC-17-051 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	43 bidders	The Regents of the University of California, San Diego	N/A ****	N/A	N/A	Yes; Calif Based Entity	This project could lead to technological advancement in lightwave technology for datacenters. It could double the efficiency of datacenters by increasing the speed of response and reducing energy input.	1c, 1f, 2a	The recipient has completed the project and successfully developed its optical switch and the necessary transmitter and receiver to revolutionize data centers. Currently, fiber optical lines are used for internet, but data centers are still using electrical lines to each data center rack. Using light signals in the optical switches is expected to increase energy efficiency by 50% and would be able to process data a lot faster. The data processing speed is one of the main driving factors in consumer appeal for data centers and should be easily marketed in the data center industry. Recipient is seeking additional funding to further the technology development.
EPC-17-052 Urban Microgrids for Grid Resiliency and Disaster Readiness	Pre-existing intellectual property identified in agreement EPC-17-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Gridscape Solutions, Inc.	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity, Minority Owned	This project is leading to technological advancement and breakthroughs by developing and demonstrating the ability to remotely operate multiple microgrids, which can be useful for keeping all critical functions operational in the event of a grid outage, reducing utility costs, and minimizing the reliance on diesel backup generators.	1a, 3h, 4a, 5a, 5b	A standardized third generation Gridscape EnergyScope Microgrid System (Microgrid-in-a-box), which integrates a battery energy storage system, interconnection relay, inverter, controller, and other components was developed, built and installed for testing in the Gridscape lab in Fremont. This system can be scaled-up or scaled-down for the energy need of any site. A direct purchase agreement with the City of Fontana was executed in May 2019 to deploy five microgrids at the city hall, police headquarters, community senior center, community service center, and public works department. The City of Fontana Microgrids are in the design phase and expected to be completed in the third quarter of 2020. Gridscape is also in the process of finalizing sites selections in two other Cities for microgrid deployment.
EPC-17-053 Santa Rosa Junior College Urban Microgrid Project	Pre-existing intellectual property identified in agreement EPC-17-053 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Sonoma County Junior College District/ Santa Rosa Junior College	Group 3: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project will result in advancements in the deployment of a microgrid, including the use of storage technologies, adaptive load management, and the monetization of microgrid assets while providing community support facilities in times of need. This project will also demonstrate coordination of multiple large energy storage devices with different dynamic capabilities. By demonstrating a local approach to stabilizing utility grid frequency, the microgrid will be transformed from a source of load transients to a point of stabilization reaching far beyond the point of interconnection.	1c, 1g, 1h, 2a, 3f, 3h, 4a, 4b, 5a, 5b, 5d	The design team has finished the submeter drawings, which are read-only meters. The steel structure for the Zumwalt Solar Carport Structure has been completed and solar panels have been installed, so now all three PV parking structure installations are complete and operational. The team started the microgrid modeling using Xendee software. The team has begun working with PG&E on the design for new point of interconnection switchgear, with discussions about project goals and where they can interface with PG&E to work together.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-054 Rialto Resilient Clean Power Microgrid	Technology Demonstration and Deployment	The project will install an advanced microgrid system that will include 2.0 MWh of battery electric storage, a 2.0 MW biogas-fueled cogeneration unit, and a microgrid control system at the Rialto Bioenergy Facility (RBF). The microgrid will manage the distributed energy resources to meet loads at the RBF, while minimizing grid draw and enhancing renewable electricity export. Additionally, the microgrid will enable the operations to continue indefinitely in the event of a grid outage using available feed stock (i.e., food waste and biosolids).	7/11/2018	No	Grid Operations/ Market Design	$5,000,000	$5,000,000	$486,993	N/A	$486,993	$0	$0	The Grant Farm, Inc; Rialto Bioenergy Facility LLC; Trinity Consultants; Southern Electric	$6,515,000	56.6%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-17-055 Redwood Coast Airport Microgrid	Technology Demonstration and Deployment	This project is a community scale renewable energy microgrid located at the California Redwood Coast Humboldt County Airport. It will demonstrate the first multi-customer, front-of-the-meter microgrid with renewable energy generation owned by a CCA (Redwood Coast Energy Authority or RCEA) and the microgrid circuit owned by an IOU (PG&E). This microgrid will allow the CCA to participate in the CAISO wholesale electricity market and provide low carbon resilience to a commercial airport and U.S. Coast Guard Air Station, which are critical emergency facilities in Humboldt County.	6/13/2018	No	Distribution	$5,000,000	$5,000,000	$220,833	N/A	$220,833	$500,449	$0	Humboldt State University Sponsored Programs Foundation; Redwood Coast Energy Authority	$6,322,728	55.8%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-001 Port Hueneme Navy Data Center Microgrid	Technology Demonstration and Deployment	This project will demonstrate a standardized, high-penetration distributed energy resource (DER) microgrid to support a data center at the Naval Surface Warfare Center - Port Hueneme Division near Oxnard, CA. The data obtained on capital cost, operating cost, performance and lessons learned will support commercial deployment for both military and non-military applications.	9/21/2018	No	Grid Operations/ Market Design	$4,998,345	$4,998,345	$86,006	N/A	$86,006	$848,609	$0	Distributed Utility Associates; Electric Power Research Institute, Inc.; Schweitzer Engineering Laboratories, Inc.	$3,502,754	41.2%	Grant

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EPC-17-054 Rialto Resilient Clean Power Microgrid	Pre-existing intellectual property identified in agreement EPC-17-054 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Rialto Bioenergy Facility LLC	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This project will demonstrate the business case for a microgrid that can improve operations of a food and biowaste treatment facility, as well as a wastewater treatment facility, located in a disadvantaged community. The microgrid will use a microgrid controller to optimize a biogas cogeneration system, fueled by available feedstock, and utilize energy storage to enable the facility to continue operations during a grid outage. This project will demonstrate the microgrid's ability to provide benefits to the residents of the disadvantaged community by providing opportunities to participate in demand response activities, providing cleaner air quality, and increasing grid reliability and resiliency. The business case could be applicable to the 156 critical waste water treatment plants across California.	1b, 1e, 1f, 1h, 4a, 4b, 4d, 4e, 5b, 5f	In 2019, the project team finalized purchases of combined heat and power (CHP) units, inverters, and batteries. The team also completed supporting CHP infrastructure including natural gas pipelines, biogas pipelines, and electrical and controls conduit installation. Finally, the team developed the Testing and Commissioning Plan to outline the microgrid system operation and testing procedures.
EPC-17-055 Redwood Coast Airport Microgrid	Pre-existing intellectual property identified in agreement EPC-17-055 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Humboldt State University Sponsored Programs Foundation	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	In order to manage increased DERs, California needs sophisticated DER management systems and strategies, and microgrids can play an important role. This project will lead to significant technological advancements and breakthroughs by designing the microgrid to provide both end-use customer support and wholesale market participation. Furthermore, PG&E will develop engineering standards, testing protocols, and equipment specifications for multi-customer, front-of-the-meter microgrids within their distribution system. RCEA will collaborate with PG&E to create experimental tariffs and agreements for development and operation of the microgrid. These tariffs and agreements will become important examples to other IOUs and CCAs and inform the CPUC's microgrid tariff proceeding.	1a, 1b, 1i, 2a, 3h, 5a	The project team defined the microgrid system architecture and executed fixed price contracts for the battery energy storage system, solar PV system, and microgrid controls. The microgrid design neared 100% completion. The microgrid construction activities are anticipated to start in early 2020 and end in early 2021. The project team made substantial progress on the microgrid experimental tariff development and will provide input to the CPUC's microgrid tariff proceeding. The project team also participated in the CAISO Hybrid Resource Initiative. This initiative will have an impact on the project because the wholesale generator interconnection to the CAISO grid will be a hybrid resource (DC-coupled PV battery).
EPC-18-001 Port Hueneme Navy Data Center Microgrid	Pre-existing intellectual property identified in agreement EPC-18-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	54 out of 60 bidders	Electric Power Research Institute, Inc.	Group 1: Ranked # 6	N/A	N/A	No	This project is developing new approaches to microgrids that can ensure stable power to sensitive components, such as in data centers. The team will demonstrate a standardized microgrid, analyze and define the savings and market barriers, and provide new, valuable performance data that will be used to develop a viable market for future deployments.	1a, 1b, 1e, 1h, 1i, 2a, 5a	EPRI conducted engineering analysis for the microgrid system design and coordinated these activities with the Naval Base host. The team finalized the microgrid system architecture and signed a fixed price contract with Northern Reliability, Inc. for the battery modules. Factory acceptance testing of the battery modules is expected to be completed in the second quarter of 2020; and the battery modules will be shipped to the Naval Base in the third quarter of 2020 for further testing, commissioning and safety certification prior to installation at the data center project site. EPRI also finalized the electrical diagram of microgrid connections to the SCE on-site transformer which provides power to the database center.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-002 California Test Bed Initiative	Market Facilitation	This project will develop and implement a voucher program to provide clean energy companies access to testing facilities to test and/or certify prototypes of pre-commercial distributed energy resource technologies, and help them refine their prototype to meet customer specifications. This project will start with an initial network of testing facilities that includes 29 University of California facilities from nine campuses and two National Laboratory facilities. The project intends to grow this network throughout the duration of the project. This network of testing facilities will connect testing facilities throughout California, which would otherwise be disconnected, in order to serve clean energy companies more efficiently and effectively throughout all of California.	12/10/2018	No	Demand-side Management	$10,999,701	$10,999,701	$0	N/A	$0	$566,364	$0	California Clean Energy Fund dba CalCEF Ventures; University of California, Office of the President	$887,053	7.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-003 Ultra-thin Flexible LED Lighting Panels	Applied Research and Development	The project will produce a custom thin, flexible lighting platform technology for making material-efficient and aesthetically pleasant wide-area LED lighting luminaires at a fraction of the cost of traditional fluorescent and LED fixtures. The objective is to create a universal, area-distributed LED source and associated luminaire technology platform that would (1) set a new standard for wide-area luminaire efficiency, (2) provide much lower cost of ownership compared to other lighting technologies, and (3) dramatically improve aesthetics of lighting fixtures and provide virtually unlimited design opportunities through introducing thin and flexible forms.	1/9/2019	Yes	Grid Operations/ Market Design	$1,692,069	$1,692,069	$192,732	N/A	$192,732	$516,434	$0	IVESTA LLC	$169,207	9.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-004 Accelerating Commercializati on of Advanced Energy Efficient Windows	Applied Research and Development	This project will scale Ubiquitous Energy's ClearView PowerTM technology to meet the size requirements and specifications needed for window production. ClearView PowerTM is a transparent solar coating that, when applied to glass, selectively absorbs and converts non-visible light to electricity while also blocking the infrared light that causes heat gains in buildings. As part of this project, Ubiquitous Energy will demonstrate that the solar coating application can integrated into a standard glass manufacturing process.	1/9/2019	Yes	Grid Operations/ Market Design	$2,998,055	$2,998,055	$406,015	N/A	$406,015	$407,192	$0	Lawrence Berkeley National Laboratory; Ubiquitous Energy, Inc.	$4,310,659	59.0%	Grant

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EPC-18-002 California Test Bed Initiative	Pre-existing intellectual property identified in agreement EPC-18-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	15 out of 15 bidders	California Clean Energy Fund dba CalCEF Ventures	Group 1: Ranked # 1	N/A	N/A	No	CalTestBed will accelerate new, clean, energy-efficient technologies to market and, as a result, reduce ratepayer costs. By early engagement of target customer groups in the refinement of product specifications and the evaluation of commercial viability, CalTestBed will accelerate the rate of development and commercialization of technologies that improve California's air, water and energy profile and drive economic investment, business creation and jobs.	2a, 3a, 3b, 3e	In 2019, the recipient focused on developing and finalizing all materials, plans, and processes necessary to launch the CalTestBed voucher program, including test bed directories, solicitation manuals, and user agreements. The project held a launch event in November 2019 at the UC San Diego campus. The project will issue its first solicitation for vouchers in early 2020.
EPC-18-003 Ultra-thin Flexible LED Lighting Panels	Pre-existing intellectual property identified in agreement EPC-18-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	Lucent Optics, Inc.	Group 1: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	This project could improve understanding of metrics and test procedures associated with LED quality and performance; increase the ability of commercial building operators/owners to comply with future energy codes and standards; produce higher quality LED products; and, increase consumer acceptance of LED lighting luminaires.	1e, 1f, 1h, 2a, 3a, 3b, 4a	In 2019, Lucent Optics has performed electrical and optical testing on the new experimental high-performance LED strips modules for prototyping the wide-area thin, flexible LED lighting panels. From the successful testing result, Lucent Optics will be able to determine the constraints within the design package to create the optimal improvement strategy for the next stage of the prototype. Lucent Optics is also planning to rework the principal structure of the lighting panel to enable large light-emitting areas with minimal light spillage, which will help the technology toward its goal for distributed lighting with high efficiency without glare.
EPC-18-004 Accelerating Commercialization of Advanced Energy Efficient Windows	Pre-existing intellectual property identified in agreement EPC-18-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	Ubiquitous Energy, Inc.	Group 1: Ranked # 1	N/A	N/A	No	The mass-market commercialization of clear windows that generate renewable energy and premium insulation will provide demonstrable improvements over existing low-E windows currently used in commercial buildings. This will allow California to better design and create zero net energy (ZNE) buildings to meet the state's energy efficiency goals. Furthermore, CVP's solar generating capabilities would broaden the application and generation of solar energy throughout California.	1e, 1f, 2a	The project kicked off in April 2019 and the team immediately began testing on smaller R&D prototypes both internally for optical performance, and at LBNL for validation measurement. The results were mostly consistent and met performance expectations. LBNL also started modeling and test cases, accounting for electricity generation from heat gains for the first time ever. In October, Ubiquitous Energy held a grand opening marking expansion of their plant in Redwood City for production of their larger sized samples (14" x 20"). Additionally, they installed a 2x3 panel of the larger sized prototype glass panes at their offices in November. Next year the team will continue to test and refine the larger prototype samples to ensure they meet performance and commercialization requirements, engage with window manufacturers, and identify opportunities for possible pilot demonstrations.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-005 Building Energy Impact Analysis of Low Cost NanoEC Electrochromic Window Control Algorithm Optimization	Technology Demonstration and Deployment	Heliotrope's NanoEC is the first neutral grey electrochromic window product that achieves a price point less than $25/sq. ft. This project is aiming to evaluate and optimize the building energy impact of this electrochromic smart window. By reaching the color/cost barriers needed to create mass adoption, Heliotrope will use this project to design, test, and validate energy conservation in building applications through field installations at both a test bed facility and at a real world commercial facility. Data from this study will help optimize window tinting control algorithms to achieve the lowest building energy consumption.	1/9/2019	Yes	Demand-side Management	$3,667,104	$3,667,104	$1,757,696	N/A	$1,757,696	$1,182,911	$0	Heliotrope Technologies, Inc.	$952,276	20.6%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-006 Radiative Sky Cooling-Enabled Efficiency Improvements on Commercial Cooling Systems	Applied Research and Development	This project is demonstrating a technology that will enable new and existing air conditioning and refrigeration systems to run more efficiently and in certain applications replace AC units with a cooling system requiring only the energy to run a pump. The technology being demonstrated is a rooftop-mounted, radiative sky-cooling panel that has a specialized film to enable daytime radiative cooling. The panels cool without evaporating water and only require electricity to run a small circulating pump. The cooling effect from the panels occurs all day, which is well aligned with the 24/7 operation of refrigeration systems in supermarkets and air conditioning systems in data centers and hotels. In this project, SkyCool Panels will demonstrate its use cases at two sites. The first site's panels will pair with thermal storage and an indoor radiant cooling system to demonstrate a reduction of electricity use for air conditioning by as much as 50% relative to conventional cooling systems. The second site's panels will act as a passive subcooler in a commercial supermarket to increase the system efficiency as much as 10%.	2/20/2019	Yes	Demand-side Management	$1,770,563	$1,770,563	$9,238	N/A	$9,238	$406,651	$0	Electric Power Research Institute, Inc.; SkyCool Systems Inc.	$288,386	14.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-007 High Efficiency Dynamic Lighting Systems	Applied Research and Development	The purpose of this project is to develop, smart, high-efficiency lighting products that dynamically target light to wherever is needed. For this project, Glint will develop the intuitive control systems and a luminaire motorization system to meet long term durability targets. Furthermore, Glint will demonstrate a sensor-linked luminaire that tracks room occupants and directs a task light that follows their location. This novel capability in solid-state lighting, will improve not only the efficiency with which light is generated, but also the efficiency with which it is utilized. In addition to reduced operating energy, these lighting products will provide new functionality, enable customer cost savings by reducing the number of installed luminaires needed, and provide improved lighting quality and safety in the lit environment.	1/9/2019	Yes	Demand-side Management	$1,999,990	$1,999,990	$830,884	N/A	$830,884	$43,764	$0	Glint Photonics, Inc.; Chaz Teplin	$200,064	9.1%	Grant

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EPC-18-005 Building Energy Impact Analysis of Low Cost NanoEC Electrochromic Window Control Algorithm Optimization	Pre-existing intellectual property identified in agreement EPC-18-005 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	Heliotrope Technologies, Inc.	Group 2: Ranked # 2	N/A	N/A	No	This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by developing a dynamic glass technology that will reduce HVAC energy consumption. By optimizing the control algorithm design in this project, Heliotrope's NanoEC electrochromic smart windows will improve thermal management within buildings. This technology is also showing an increase in light energy savings while providing product improvement of color and overall cost.	1e	In 2019, Heliotrope Technologies established the varying control factor of voltage and current with the smart panel unit at four different stages of lighting (with extremes being transparent to opaque) to measure the capability of performance on color composition, lighting energy, thermal comfort, and daylight illuminance. These results will contribute to creating controlled electronics for an autonomous dimming window system for standard size smart panel units within commercial buildings. This window system will be able to tint on-demand based on feedback from an automated electronic sensor, achieve the desired tint state based on user preference, and communicate with any adjacent window to ensure that all windows tint at the same rate and level.
EPC-18-006 Radiative Sky Cooling-Enabled Efficiency Improvements on Commercial Cooling Systems	Pre-existing intellectual property identified in agreement EPC-18-006 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	SkyCool Systems Inc.	Group 1: Ranked # 6	N/A	N/A	Yes; Calif Based Entity	This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals. It will enable the measurement and verification of two promising integrations for a platform cooling technology in operational commercial settings, the results of which might not otherwise have been deployed if pursued purely through a competitive consumer market. SkyCool technology will help California reach policy goals set out in SB 350, AB 32, and AB 758 by reducing barriers for installing the panels in commercial systems and enable the broader adoption across California's cold chain and HVAC sectors.	1e, 1f, 1h, 2a, 3a, 4a, 4c	The SkyCool team has focused its efforts on streamlining the layout and deployment of panels connected with refrigeration systems in supermarkets, restaurants and convenience stores. Since the start of the project, the team developed a tool to size panel arrays, heat exchangers and pumps based on the cooling capacity of the air conditioning and refrigeration system. Current work has been focused on finalizing the site plans to begin installation of a panel array in a refrigeration system in the first half of 2020.
EPC-18-007 High Efficiency Dynamic Lighting Systems	Pre-existing intellectual property identified in agreement EPC-18-007 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	Glint Photonics, Inc.	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This technology can provide substantial energy savings in California's lighting sector, contributing to the state's Senate Bill 350 energy efficiency savings, and Zero Net Energy Buildings goals outlined in the CPUC's Energy Efficiency Strategic Plan. An estimated savings of up to 18.5 TWh, annually, can be realized in California's investor-owned utility service territories, alone.	1f, 1h, 3h	The recipient has successfully completed a proof-of-concept hardware test, designed to evaluate the capability for the chosen hardware controller approach. Additionally, Glint has tested an initial mechanical motorization design to over 10,000 cycles without any evidence of degradation and will continue cycle testing on new designs. In the coming months, the recipient will be working to complete the fabrication of their prototype, which will serve as a testbed platform for control system development.

Invest-ment Program Period	Program Admin-istrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immed-iately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date: Contract/ Grant Amount ($)	Funds Expended to date: In house expend-itures ($) *****	Funds Expended to date: Total Spent to date ($)	Admin-istrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechan-ism
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-008 Improving Energy Efficiency and Performance of Wastewater Recycling	Applied Research and Development	This project will advance the RNEW (Recycle Nutrients Energy and Water) process, which will overcome the seasonal limitation of current wastewater treatment pond processes by the selective use of mechanical aeration to optimize wastewater treatment in winter months and incorporating a two-stage process of biomass settling and filtration for algae - biomass harvesting. The products resulting from this process are unrestricted reuse water, and biomass that can be used to generate biofuels and fertilizers. RNEW is suitable for both small and large communities. The RNEW process can be applied to new, or retrofitted to existing, wastewater treatment plants. The technological and scientific knowledge being advanced by this project are the controlled operation of intensive high-rate algal ponds for year-round wastewater treatment. This includes low-cost harvesting of the algal biomass by a combined algal settling and membrane separation for recovery of energy, fertilizers and reclaimed water.	2/20/2019	Yes	Demand-side Management	$1,550,227	$1,550,227	$0	N/A	$0	$548,356	$200,000	MicroBio Engineering, Inc.	$160,000	9.4%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-009 Energy Savings Through Osmotic Concentration for the Food and Beverage Processing Industry	Technology Demonstration and Deployment	Porifera will demonstrate a commercial-scale system that offers an energy efficient way to create high quality concentrates without using heat or pressure. They will build and install their PFO Concentrator system, using an innovative forward osmosis technology to reduce energy, chemicals, and maintenance required for food and beverage processors. The system will be installed for operations at a watermelon processing plant in California, for the duration of three consecutive processing seasons. The team will generate and analyze various juice samples throughout the season and post-season, and make refinements to the system until a third and final configuration is able to demonstrate production of a sellable concentrate that is superior to current quality levels. Porifera is also partnering with the U.S. Department of Agriculture (USDA) to study and produce freeze-dry products from the concentrates to demonstrate other applications of the system. Measurement and Verification will be performed by the USDA and results will be shared with Energy Commission staff, industry stakeholders, and the demonstration host site.	3/12/2019	Yes	Demand-side Management	$2,800,687	$2,800,687	$685,215	N/A	$685,215	$908,606	$0	Porifera, Inc.	$605,073	17.8%	Grant

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EPC-18-008 Improving Energy Efficiency and Performance of Wastewater Recycling	Pre-existing intellectual property identified in agreement EPC-18-008 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	MicroBio Engineering, Inc.	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	This project will advance the science and engineering of algae wastewater treatment systems, to enable current and future California wastewater plants to reduce net electricity consumption while improving plant performance and lower overall costs. The RNEW (Recycle Nutrients Energy and Water) technology has projected 80% lower electricity consumption and 50% lower annualized capital and operating costs than conventional activated sludge, and meets California's Title 22 recycled water standards, with much lower nutrient effluent concentrations than currently required.	1e, 1f, 1h, 2a, 3a, 3b, 4a	This agreement was executed on June 24, 2019. Overall, the project is on schedule. The recipient has already completed the following in preparation for testing and advancing their RNEW technology of recovering nutrients, energy, and water from wastewater sources toward commercialization: - The initial pilot plant design and site configuration for Test Set 1 (nitrogen conversion improvement testing) was completed and configuration for Test Set 2 (nitrogen treatment optimization testing) was initiated. - Installation of pilot plant units began at the end of September 2019 for Test Set 2 and the process of procurement for modifications to Test Set 1 was also initiated. In the closing of 2019, and early 2020, the recipient will focus on the following: - Completing the setup and configuration for Test Set 2. - Completing the Effluent Selection and Facility Reconfiguration Report.
EPC-18-009 Energy Savings Through Osmotic Concentration for the Food and Beverage Processing Industry	Pre-existing intellectual property identified in agreement EPC-18-009 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	Porifera, Inc.	Group 2: Ranked # 1	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	This project will help the state achieve its statutory energy goals by demonstrating an innovative technology that can produce juice concentrate and freeze-dried powder products that meet food safety standards, is cheaper, and more energy efficient than current mainstream thermal evaporator systems.	1f, 1h, 3a, 3g, 4a, 4c, 4d, 4e	Porifera has successfully installed their forward osmosis concentrator at their demonstration site hosted by Van Groningen & Sons, a third-generation California watermelon grower and processor. With the close of the watermelon season the team has processed 10,700 kg of fresh juice into 1381 kg of 65 brix juice concentrate. Samples are being shipped out from the host site to potential product developers for feedback on the quality of the concentrate. The team is preparing their season one report where they will identify system improvements for the next season.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-010 Energy and Water Savings in Food and Beverage Wastewater Reuse	Applied Research and Development	The goal of this agreement is to develop new capabilities with the Porifera Forward Osmosis (PFO) Recycler so that it can treat high-starch wastewater from food and beverage manufacturing facilities and turn it into clean water for onsite reuse. If successful, this project will open up new market opportunities for the PFO Recycler and provide California's food and beverage manufacturers with a new energy efficient solution to rising water prices and wastewater disposal costs.	3/12/2019	Yes	Demand-side Management	$1,777,132	$1,777,132	$182,892	N/A	$182,892	$480,430	$0	Porifera, Inc.	$195,000	9.9%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-011 ** Lancaster Advanced Energy Community (AEC) Project	Technology Demonstration and Deployment	This project will deploy energy storage and microgrids at sites throughout Lancaster and integrate these DERs into a first-of-its-kind Virtual Power Plant (VPP). The project will demonstrate the power of local renewables, storage, and flexible load to balance the local grid, mitigate the duck curve, and provide valuable new grid services. These shovel-ready projects include two master-metered, ZNE affordable housing developments that island as microgrids. Renewable microgrids will be deployed at three Lancaster city schools, allowing these schools to provide critical services and act as shelters in an emergency. In addition, 3 MWh of energy storage will be deployed at commercial sites throughout Lancaster via the Lancaster Green District program, which will demonstrate an innovative public-private partnership model. All of these resources will be integrated into the Lancaster VPP, which will enable optimized performance of 5 MW of solar PV and 10 MWh of energy storage. The Lancaster VPP will demonstrate how local load-serving entities can help mitigate the problem of solar over-generation and intermittency with economic DER solutions.	5/15/2019	Yes	Grid Operations/ Market Design	$3,738,300	$3,738,300	$147,003	N/A	$147,003	$809,583	$0	City of Lancaster; Amber Kinetics, Inc.; Gridscape Solutions, Inc.; Blue Strike Environmental, Inc.; Lancaster School District	$5,674,720	53.2%	Grant

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EPC-18-010 Energy and Water Savings in Food and Beverage Wastewater Reuse	Pre-existing intellectual property identified in agreement EPC-18-010 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	21 out of 33 bidders	Porifera, Inc.	Group 1: Ranked # 4	N/A	N/A	Yes; Calif Based Entity, Minority Owned, Woman Own	California recognizes the relationship between water use and energy use. California food and beverage processors are large energy and consumers. This project has the potential to produce an energy efficient method for treating water at the source of its production.	1f, 1h, 3a, 4c, 4d, 4e	Porifera is currently in the development of their initial PFO recycler. The team is working with Frito-Lay to arrange the terms of their initial testing of treating wastewater consisting of high starch content. The team, meanwhile, has been in the lab setting up the system to soon begin analysis on test samples from the site. The system is scheduled for installation and field testing in quarter three of 2020.
EPC-18-011 ** Lancaster Advanced Energy Community (AEC) Project	Pre-existing intellectual property identified in agreement EPC-18-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	9 out of 9 bidders	Zero Net Energy (ZNE) Alliance	Group 6: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will support the development and commercialization of technological advancements and breakthroughs that overcome barriers to the achievement of the State of California's statutory energy goals by demonstrating a virtual power plant that can optimize the value and improve the economic attractiveness of distributed energy resources. In addition, the project will act as a demonstration for promising technical solutions that will lower costs and provide superior operational value, including a side-by-side demonstration of flywheel and lithium-ion storage systems, as well as several deployments of modular microgrids.	1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a, 3a, 3b, 3f, 4a, 5a	This project kicked-off in July 2019. For the remainder of the year, the project team focused on completing planning activities including finalizing the residential microgrid model, the VPP integration plan, and the microgrid cost model for both the residential installation sites and the resilient schools network. In 2020 the project team will begin construction of the planned microgrid installations.

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2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-011 ** Lancaster Advanced Energy Community (AEC) Project	Technology Demonstration and Deployment	This project will deploy energy storage and microgrids at sites throughout Lancaster and integrate these DERs into a first-of-its-kind Virtual Power Plant (VPP). The project will demonstrate the power of local renewables, storage, and flexible load to balance the local grid, mitigate the duck curve, and provide valuable new grid services. These shovel-ready projects include two master-metered, ZNE affordable housing developments that island as microgrids. Renewable microgrids will be deployed at three Lancaster city schools, allowing these schools to provide critical services and act as shelters in an emergency. In addition, 3 MWh of energy storage will be deployed at commercial sites throughout Lancaster via the Lancaster Green District program, which will demonstrate an innovative public-private partnership model. All of these resources will be integrated into the Lancaster VPP, which will enable optimized performance of 5 MW of solar PV and 10 MWh of energy storage. The Lancaster VPP will demonstrate how local load-serving entities can help mitigate the problem of solar over-generation and intermittency with economic DER solutions.	5/15/2019	Yes	Grid Operations/ Market Design	$1,260,760	$1,260,760	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-012 Production Scale-Up of Low-Cost, Long-Life Flow Battery	Market Facilitation	This Agreement funds the EnergyPod scale-up from MRL 7 (Manufacturing Readiness Level) to MRL 8. The EnergyPod is a zinc bromide flow battery that offers energy storage with an estimated five hours of continuous output at 25 kW, a useful life of 20 years, no electrode stack replacement and no fire risk.Li-ion strengths include maturity and price point. Li-ion weaknesses include fire danger and fade of delivered power over time. Flow batteries do not pose fire risks and generally do not fade over time. At scale, well-designed flow batteries should have a significant cost advantage over other technologies, including Li-ion.The Recipient (Primus) will transition to a mature, high volume manufacturing process using a contract manufacturing strategy that leverages existing high-volume manufacturing equipment and processes. Primus will receive the major subassemblies for the flow battery from contract manufacturing partners and complete the final assembly in its existing facility. Using this new process of outsourced manufacturing; Primus will be able to increase production while lowering costs, which will lead to Primus' ability to offer more cost effective energy storage.	6/12/2019	Yes	Grid Operations/ Market Design	$4,000,000	$4,000,000	$0	N/A	$0	$400,000	$0	Primus Power Corporation	$6,319,321	61.2%	Grant

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EPC-18-011 ** Lancaster Advanced Energy Community (AEC) Project	Pre-existing intellectual property identified in agreement EPC-18-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	9 out of 9 bidders	Zero Net Energy (ZNE) Alliance	Group 6: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will support the development and commercialization of technological advancements and breakthroughs that overcome barriers to the achievement of the State of California's statutory energy goals by demonstrating a virtual power plant that can optimize the value and improve the economic attractiveness of distributed energy resources. In addition, the project will act as a demonstration for promising technical solutions that will lower costs and provide superior operational value, including a side-by-side demonstration of flywheel and lithium-ion storage systems, as well as several deployments of modular microgrids.	1a, 1b, 1c, 1e, 1f, 1h, 1i, 2a, 3a, 3b, 3f, 4a, 5a	This project kicked-off in July 2019. For the remainder of the year, the project team focused on completing planning activities including finalizing the residential microgrid model, the VPP integration plan, and the microgrid cost model for both the residential installation sites and the resilient schools network. In 2020 the project team will begin construction of the planned microgrid installations.
EPC-18-012 Production Scale-Up of Low-Cost, Long-Life Flow Battery	Pre-existing intellectual property identified in agreement EPC-18-012 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Primus Power Corporation	Group 3: Ranked # 1	N/A	N/A	Yes; Micro Business, Calif Based Entity	This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by scaling up production of the Recipient's flow battery with rated power of 25kW and discharge energy of 125 kWh. Primus' technology offers a battery with no membrane, single flow loop and high voltage with low cost chemistry. The Recipient's flow battery differs from traditional flow batteries in that it does not require an ion exchange membrane and it uses a single electrolyte flow loop. These differences provide significant competitive advantages because they require fewer parts and have longer system cycle life, higher power density, higher reliability and reduced safety risks. The Recipient's flow battery units may be interconnected with each other to form larger energy storage systems.	1i, 2a, 3a, 3b, 3h, 4a, 5d, 5e	This agreement was executed on August 8, 2019. In fall of 2019, and continuing in 2020, the recipient is focusing on preparing their facility for manufacturing their product (EnergyPod 2) at scale, and testing their product and refining its design for manufacturability. This will include buying and installing equipment for manufacturing at scale, followed by performing initial production tests with design refinements, certifying their product's design, and performing pilot production tests to prepare their product for Low Rate Initial Production.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-013 ** The Oakland EcoBlock, Phase II: A Zero Net Energy, Low Water-Use Retrofit Neighborhood	Technology Demonstration and Deployment	Leveraging economies of scale, the EcoBlock advances a new model for scaling DER in existing neighborhoods through holistic block-scale retrofitting that combines deep energy efficiency retrofit strategies, integrated distributed energy generation systems, and water conservation and capture systems in a low-to-middle income neighborhood in the City of Oakland. This project is the second Phase of the EPIC Challenge: Accelerating the Deployment of Advanced Energy Communities. This project will implement the master plan developed in Phase I.	6/12/2019	Yes	Grid Operations/ Market Design	$3,740,181	$3,740,181	$0	N/A	$0	$700,249	$0	City of Oakland; EMerge Alliance; Morgan, Lewis & Bockius LLP; Spectrum Energy Development, Inc.; Spie Batignolles; ARDA Power Inc.; Rexel USA, Inc. DBA Platt Electric Supply; Building and Construction Trades Council of Alameda, AFL-CIO; Stanford University - Civil and Environmental Engineering; Siegel & Strain Architects	$3,491,600	41.1%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-013 ** The Oakland EcoBlock, Phase II: A Zero Net Energy, Low Water-Use Retrofit Neighborhood	Technology Demonstration and Deployment	Leveraging economies of scale, the EcoBlock advances a new model for scaling DER in existing neighborhoods through holistic block-scale retrofitting that combines deep energy efficiency retrofit strategies, integrated distributed energy generation systems, and water conservation and capture systems in a low-to-middle income neighborhood in the City of Oakland. This project is the second Phase of the EPIC Challenge: Accelerating the Deployment of Advanced Energy Communities. This project will implement the master plan developed in Phase I.	6/12/2019	Yes	Grid Operations/ Market Design	$1,259,819	$1,259,819	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-014 Production Scale-Up of Thermionic Energy Harvesters	Market Facilitation	This agreement is to fund the production scale-up of Spark Thermionics' thermionic energy converter, to low rate production stage. When combined with next-generation CSP, the Recipient's technology can increase the power output by 75-90% relative to today's best CSP plants. This additional power can drive down the cost to 5.6 cents/kWh. Under this agreement, the project team will analyze cost reduction for process development and manufacturing for the core and encapsulation components within the energy harvesters. The project will also validate that the thermionic topping cycle within the energy harvester has adequate heat rejection from CSP that would be necessary for thermal energy storage (TES) to increase the efficiency and power output of a power generating system. With this technology, flexible generation can address the grid-level challenges of solar PV-generated electricity, namely variability, uncertainty, and nonsynchronous generation.	6/12/2019	Yes	Grid Operations/ Market Design	$1,349,933	$1,349,933	$20,460	N/A	$20,460	$184,914	$1,650,000	Spark Thermionics, Inc	$270,000	16.7%	Grant

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EPC-18-013 ** The Oakland EcoBlock, Phase II: A Zero Net Energy, Low Water-Use Retrofit Neighborhood	Pre-existing intellectual property identified in agreement EPC-18-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	9 out of 9 bidders	The Regents of the University of California, Berkeley	Group 5: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The EcoBlock uses a holistic process to block-scale retrofitting of residential and mixed-use neighborhoods that: (1) undertakes deep efficiency and electrification retrofits in buildings, (2) harnesses local renewable resources to reduce the households' energy, transportation, and water footprint. The EcoBlock's microgrid will be a permanent installation that provides a unique opportunity for a resilient microgrid that uses commercially available technologies. The EcoBlock microgrid demonstration includes five DERs applied in the California loading order: DER 1: energy efficiency retrofits and electrification of major home equipment; DER 2: controllable/deferrable loads for demand response; DER 3: electrification of transportation using EV's; DER 4: serving remaining load with a DC microgrid system powered by communal rooftop PV; and DER 5: a central energy storage system.	1f, 4a	Work on this agreement began in October 2019. After conducting outreach and corresponding with residents of the residential block planned for this demonstration, the project team decided to select a new block in Oakland. UC Berkeley has put together technical criteria for selecting a new demonstration site. Eleven neighborhoods in Oakland have applied to be the new Ecoblock site. Once the new site has been selected, the recipient plans to conduct deep energy audits on the residences and use the data to create engineering and design documents. In 2020, the recipient also plans to establish a Community Facilities District which will allow residents to collectively finance the ongoing operational and maintenance costs of the communal energy and water installations.
EPC-18-013 ** The Oakland EcoBlock, Phase II: A Zero Net Energy, Low Water-Use Retrofit Neighborhood	Pre-existing intellectual property identified in agreement EPC-18-013 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	9 out of 9 bidders	The Regents of the University of California, Berkeley	Group 5: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The EcoBlock uses a holistic process to block-scale retrofitting of residential and mixed-use neighborhoods that: (1) undertakes deep efficiency and electrification retrofits in buildings, (2) harnesses local renewable resources to reduce the households' energy, transportation, and water footprint. The EcoBlock's microgrid will be a permanent installation that provides a unique opportunity for a resilient microgrid that uses commercially available technologies. The EcoBlock microgrid demonstration includes five DERs applied in the California loading order: DER 1: energy efficiency retrofits and electrification of major home equipment; DER 2: controllable/deferrable loads for demand response; DER 3: electrification of transportation using EV's; DER 4: serving remaining load with a DC microgrid system powered by communal rooftop PV; and DER 5: a central energy storage system.	1f, 4a	Work on this agreement began in October 2019. After conducting outreach and corresponding with residents of the residential block planned for this demonstration, the project team decided to select a new block in Oakland. UC Berkeley has put together technical criteria for selecting a new demonstration site. Eleven neighborhoods in Oakland have applied to be the new Ecoblock site. Once the new site has been selected, the recipient plans to conduct deep energy audits on the residences and use the data to create engineering and design documents. In 2020, the recipient also plans to establish a Community Facilities District which will allow residents to collectively finance the ongoing operational and maintenance costs of the communal energy and water installations.
EPC-18-014 Production Scale-Up of Thermionic Energy Harvesters	Pre-existing intellectual property identified in agreement EPC-18-014 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Spark Thermionics, Inc.	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	The high-temperature energy harvesting technology will improve the efficiency of concentrated solar power generation, reducing the capital and operating costs associated with power generating systems. The combination of having a technology that can absorb adaptable amounts of heat and then utilize the heat for time-varying electrical consumption will expedite further large-scale integration of renewable resources to enable California's highly ambitious energy goals. This technology will allow for more integration of renewables for California at a lower cost.	1b, 1e, 1f, 1h, 1i, 2a, 3b, 4a, 5d	In 2019, Spark Thermionics began analyzing the expenses for current prototypes production to begin the improvement of the cost model development. Some vital cost reductions found were in materials for the encapsulation assemblies and process for integrating the core components in the final device. These new findings are estimated to reduce one-third of the standard cost of the energy harvester. Spark Thermionics has also relocated into a larger space which will be able to accommodate in-house production of the energy harvester components. For the next stage of the project, Spark Thermionic will acquire important equipment, such as a leak detector and tube furnace, that will assist in evaluating the quality control of energy harvester components developed from new materials and streamlining the process of integrating all components in the final device.

Invest-ment Program Period	Program Admin-istrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immed-iately prior calendar year?	Assignment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date: Contract/ Grant Amount ($)	Funds Expended to date: In house expend-itures ($) *****	Funds Expended to date: Total Spent to date ($)	Admin-istrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechan-ism
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-015 Improved Batteries for California's Zero-Emissions Vehicle Future	Market Facilitation	The purpose of this Agreement is to fund the setup and commissioning of a pilot-scale production facility for manufacturing lithium-metal battery pouch cells. These innovative lithium-metal battery cells have a high energy density and are non-flammable. The Recipient has pioneered a capital-efficient approach to scale up by using low-cost foreign contract manufacturers to produce the parts of the lithium metal battery that are standard and finishing the manufacturing in-house. During in-house manufacturing, dry cells are cut open, injected with a unique electrolyte and vacuum-sealed. The Recipient hopes to avoid more than 95% of the capital expense typically required to scale up a new battery technology to pilot production while still retaining tight control over all IP (contained in the liquid electrolyte formulation and formation cycling protocols, which are all done in-house).	6/12/2019	Yes	Demand-side Management	$1,566,639	$1,566,639	$355,830	N/A	$355,830	$229,783	$1,049,989	Cuberg, Inc.	$316,200	16.8%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-016 Production Scale-Up of Advanced Wafer Technology for Drastic Solar Photovoltaics Cost Reduction	Market Facilitation	The purpose of this Agreement is to fund the production scale-up and validation of a novel solar photovoltaics wafer manufacturing technology, proven at the full-scale prototype level, to low rate production stage. This technology uses silicon laser processing technology which results in no silicon material loss and nearly five times thinner wafers and five times less variation in thickness. This new process does not require water and reduces the GHG emissions embedded in the wafer manufacturing process by 50% while increasing quality and performance.	6/12/2019	Yes	Generation	$4,000,000	$4,000,000	$0	N/A	$0	$584,267	$0	Halo Industries	$1,250,000	23.8%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-017 Scaling Up Pilot Production of Nanoporous Membranes for Battery Storage Technologies	Market Facilitation	The purpose of this project is to scale-up the production of an advanced battery membrane platform for market facilitation of safe, low-cost, and energy-dense batteries. The proposed approach is to establish optimal processes for each key component of the innovative membrane (polymer, polymer ink, and roll-to-roll coating) to generate quality assurance and quality control metrics that will lead to an in-house low rate initial production of the membrane for batteries. The intent is to establish a steady commercialized platform technology that will create multiple market opportunities in a variety of battery chemistries. The innovative membrane, in addition to improving the cycle life of batteries, enables more energy to be extracted from the same cathodes used under previously abusive conditions, operate at elevated temperatures, and allows use of more abundant materials such as manganese instead of cobalt.	6/12/2019	Yes	Grid Operations/ Market Design	$2,675,793	$2,675,793	$121,921	N/A	$121,921	$382,307	$0	Argonne National Laboratory; CAMX Power; Washington Clean Energy Testbeds; Ambrosi Donahue Congdon Certified Public Accountant	$2,489,417	48.2%	Grant

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EPC-18-015 Improved Batteries for California's Zero-Emissions Vehicle Future	Pre-existing intellectual property identified in agreement EPC-18-015 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Cuberg, Inc.	Group 3: Ranked # 5	N/A	N/A	No	This Agreement will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by enabling low rate initial production of high energy and safe lithium batteries, which increase the safety and range of electric vehicles to increase electric vehicle adoption in California. Currently, California aims to have 5 million zero emission vehicles by 2030. Enabling the scale up in pilot production scale will eventually accelerate the mass market adoption of electric vehicles as cheaper, higher range and safer electric vehicles are produced. This will assist California to achieve statutory goals as electric vehicles become more economically and functionally more appealing for the customers.	4a	This project started in June 2019 and the project team has begun acquiring the equipment and materials needed to conduct testing on how the internal manufacturing process can keep battery cell quality high while increasing output. In 2020, the project team plans to have completed initial manufacturing runs and verified they are able to produce the same or higher quality battery cells.
EPC-18-016 Production Scale-Up of Advanced Wafer Technology for Drastic Solar Photovoltaics Cost Reduction	Pre-existing intellectual property identified in agreement EPC-18-016 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Halo Industries, Inc.	Group 2: Ranked # 1	N/A	N/A	No	This Agreement will scale up and validate a novel solar wafer manufacturing technology to low rate initial production and generate significant long-term benefits in the solar photovoltaics field including: a decrease in costs associated with solar modules, an increase in the efficiency of solar modules, a reduction in the environmental impact of the manufacturing of solar modules and an enabling of next-generation solar cell/module architectures.	1c, 1h	This project started in June 2019 and the project team has begun engineering work on analysis tools that will be used to ensure the quality of the silicon wafers remain high while the manufacturing process is scaled up to low-rate initial production. In 2020, the project team plans to have completed initial manufacturing runs and verified they are able to produce the same or higher quality wafers.
EPC-18-017 Scaling Up Pilot Production of Nanoporous Membranes for Battery Storage Technologies	Pre-existing intellectual property identified in agreement EPC-18-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Sepion Technologies, Inc.	Group 3: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The nanoporous membrane platform opens paths to safely increasing Li-ion battery energy density by 15%, dropping the cost below $100/kWh by enabling inexpensive cathodes based on nickel and manganese, and mitigating battery manufacturers' supply-chain risk centered on cobalt. This technology can be integrated with existing Li-ion battery manufacturing infrastructure to reduce barriers to market entry. Beyond Li-ion batteries, this platform membrane technology is already being leveraged to enable breakthroughs in Li-metal batteries for advanced electric vehicles with greater than 350 mile range and ultra-low-cost flow batteries for long-duration grid storage, multiplying the potential for impact.	1b, 1c, 1e, 2a, 3a, 3f, 3g, 3h, 4a	In 2019, Sepion Technologies has tested five different reactor system designs and purification methods to inform the project on the proper equipment needed for the production of polymers, which is a vital component of the membrane that enables the movement of ions through the cell. Sepion has built a small-scale reactor system in-house to be used in determining parameters, which includes weight, size and melting point, for the polymer production system. Once the polymer system is finalized, Sepion will use those results to dissolve the polymer in a carrier solvent to create an ink that can easily be coated into this film membranes.

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2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-018 Prototype to Production: Modular Battery Platform Project for California Critical Infrastructure	Market Facilitation	This project will scale-up manufacturing for a dedicated, modular battery platform for critical infrastructure (initially targeting telecommunication towers) and make it possible for the manufacturing to be in California. The high-energy-density battery pack has best-of-class battery management and control software to remotely meter, monitor, and control the units. The battery platform is designed for fire resiliency and will withstand extreme temperatures. In combination with onsite renewable energy, the equipment can bring a cell tower under environmental distress back online. In case of Public Safety Power Shutoffs (PSPS), the platform can power telecommunication systems and critical infrastructure for hours or days, restoring communication immediately after a fire, no matter the damage to the grid infrastructure or power lines. The modular battery platform also can be used as a pop-up energy source to be quickly deployed to disaster areas to restore electricity for lights, water, heating, and cooling.	6/12/2019	Yes	Demand-side Management	$1,878,760	$1,878,760	$98,544	N/A	$98,544	$0	$0	Caban Systems, Inc.	$1,396,943	42.6%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-019 Treau: Low-GWP, High-Efficiency Heat Pump and Air Conditioner	Market Facilitation	This project’s purpose is to scale-up a manufacturing line of quieter, less expensive, and easy-to-install, retrofit window upgrade air conditioners and electric heat pumps. The unique design allows unfettered access to the window where the unit is placed. The proposed approach is to build successive prototypes, which will be tested for performance and usability to finalize a product ready for manufacturing scale-up. The project will result in quality assurance and quality control metrics, established relationships with suppliers, and a system design that leads to initial low-rate production of room air conditioners for the residential market. The benefits of the project, as related to the California IOU electricity ratepayers, are lower heating and cooling costs, more comfortable homes, and reduced air pollution. Successful execution of this project will accelerate the reduction of cost and emissions of building heating and cooling goals for existing building at significant scale, especially among users of window air conditioners. Additionally, this technology can provide a high-efficiency all-electric product for achieving California's new residential Zero Net Energy Action Plan.	6/12/2019	Yes	Demand-side Management	$2,805,907	$2,805,907	$67,157	N/A	$67,157	$834,152	$0	Treau, Inc.	$1,901,907	40.4%	Grant

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EPC-18-018 Prototype to Production: Modular Battery Platform Project for California Critical Infrastructure	Pre-existing intellectual property identified in agreement EPC-18-018 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Caban Systems, Inc.	Group 3: Ranked # 4	N/A	N/A	No	This project will lead to technological advancement and breakthroughs to overcome barriers to the achievement of the State of California's statutory energy goals by accelerating the production of an emerging, best-of-class energy storage technology that will improve public safety, lower costs, and reduce emissions. Ratepayers rely on critical infrastructure for communication to keep them connected during power outages often related to wildfires and severe weather events. Currently, critical infrastructure, including telecomm base stations, radio signal towers, and cell phone towers rely heavily on fossil fuel-powered generators for back-up power. To maintain communication during outages, there is an immediate need to scale-up production for a clean-energy storage platform that can provide services to critical infrastructure during outages.	1c, 1e, 1h, 1i, 2a, 3b, 3c, 4a, 4b, 5a, 5d, 5e	This agreement was executed on July 30, 2019. In the closing of 2019, and continuing into 2020, the recipient will focus on preparing their facility for manufacturing their product (a dedicated modular battery platform for critical infrastructure) at scale, and testing their product and refining its design for manufacturability. This will include buying and installing equipment for manufacturing at scale, followed by performing initial production tests with design refinements, certifying their product's design, and performing pilot production tests to prepare their product for low-rate initial production.
EPC-18-019 Treau: Low-GWP, High-Efficiency Heat Pump and Air Conditioner	Pre-existing intellectual property identified in agreement EPC-18-019 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Treau, Inc.	Group 1: Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The project would help displace low-efficiency window air conditioners, displace the use of polluting HFC refrigerants, and increase adoption of efficient air conditioners and heat pumps in homes and multi-family units. Additionally, because the Treau system uses a hermetically, factory-sealed, leak-tested refrigerant circuit, the unit substantially reduces the release of methane emissions compared to expensive mini-split systems. With energy savings up to 70% in heating, the technology can help achieve improved building efficiency goals for existing buildings in California. Additionally, Treau can provide a high-efficiency all-electric product for achieving California's residential Zero Net Energy Action Plan.	1e, 1f, 1h, 2a, 3a, 3b, 3c, 4a	Treau has already assembled an Alpha prototype of a room air conditioner and developed a prototype test plan. They built a test chamber to characterize how the unit performs on a both a system and component level. Treau is benchmarking the overall product dimensions, weight, and noise level. They are also designing and sourcing components for a Beta 1 prototype. This prototype will assess the manufacturing and supply chain needs. The results will inform future modifications for testing, component selection, design, and control of future prototypes. A dozen prototypes will be installed in Northern California homes to gather valuable consumer feedback. In 2020, Treau plans to develop and beta-test several hundred pre-launch systems and launch publicly in 2021. The goal is to deliver a manufacturing line capable of producing at least 300 HVAC units annually.

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2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-020 Production Scale-Up of High Efficiency Adjustable Lighting Products	Market Facilitation	Glint Photonics has pioneered revolutionary high-efficiency solid-state lighting products that use proprietary optical designs to provide precise control over light distribution, greatly increasing the amount of light that is delivered to the intended target and reducing unpleasant glare. The production scale-up work will focus on Glint's Hero family of luminaires. The objectives are (1) to refine the product design for production, focusing on improvements to manufacturability, quality, and cost; (2) to develop and qualify manufacturing processes, and build Glint's organizational capability to manage pilot production quality and operations; and (3) establish, qualify, and certify a pilot production line in partnership with a California-based contract manufacturer. At the conclusion of the project, the recipient will be ready to begin low-rate pilot production of Hero products and will have a strong foundation in place for scaling to mass production over time.	6/12/2019	Yes	Demand-side Management	$1,998,922	$1,998,922	$494,384	N/A	$494,384	$619,177	$0	Glint Photonics, Inc.	$399,831	16.7%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-021 ** Production Scale-Up for Next Generation Batteries Using Liquefied Gas Electrolytes	Market Facilitation	South 8 Technologies has developed a liquefied gas electrolyte chemistry with increased performance metrics to traditional Li-ion battery electrolytes. These electrolytes enable lithium metal batteries to be produced having an increased temperature range and nearly twice the specific energy compared to traditional Li-ion batteries. Additionally these lithium metal batteries eliminate the risk of thermal runaway hazards. The purpose of this Agreement is to fund the design and build-out for a Low Rate Initial Production (LRIP) pilot line for the manufacture of liquefied gas electrolyte batteries with lithium metal anodes which have high energy density and increased safety.	6/12/2019	Yes	Grid Operations/ Market Design	$231,451	$231,451	$202,365	N/A	$202,365	$230,205	$0	South 8 Technologies	$466,416	31.2%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-021 ** Production Scale-Up for Next Generation Batteries Using Liquefied Gas Electrolytes	Market Facilitation	South 8 Technologies has developed a liquefied gas electrolyte chemistry with increased performance metrics to traditional Li-ion battery electrolytes. These electrolytes enable lithium metal batteries to be produced having an increased temperature range and nearly twice the specific energy compared to traditional Li-ion batteries. Additionally these lithium metal batteries eliminate the risk of thermal runaway hazards. The purpose of this Agreement is to fund the design and build-out for a Low Rate Initial Production (LRIP) pilot line for the manufacture of liquefied gas electrolyte batteries with lithium metal anodes which have high energy density and increased safety.	6/12/2019	Yes	Grid Operations/ Market Design	$796,608	$796,608	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant

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EPC-18-020 Production Scale-Up of High Efficiency Adjustable Lighting Products	Pre-existing intellectual property identified in agreement EPC-18-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	Glint Photonics, Inc.	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This technology can provide up to 10.2 TWh annual energy savings in California IOU territories. This a very significant contributor to the state's Zero Net Energy building goals, as set out in the CPUC's Energy Efficiency Strategic Plan and the Energy Commission's IEPR. The luminaires can also help meet the California Air Resources Board's Climate Change Scoping Plan target of 32 TWh of reduced energy consumption via energy efficiency improvements.	1f, 3a, 3b, 4a	Since the kickoff, much of the work has been centered on development of supply chain partners for various components. This included a trip by two Glint employees to Asia to meet with various suppliers. The recipient has initiated work with an industrial design firm, Whipsaw to optimize the design of the Hero luminaire for manufacturability, quality and cost. In 2020, the recipient plans to refine the high-efficiency adjustable lighting product design, assembly processes, and supplier relationships required for Glint's lighting technology products to improve manufacturability, ensure quality, achieve certification, and reduce production cost.
EPC-18-021 ** Production Scale-Up for Next Generation Batteries Using Liquefied Gas Electrolytes	Pre-existing intellectual property identified in agreement EPC-18-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	South 8 Technologies	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This technology is advancing alternatives to Li-ion batteries that increase the safety of energy storage while also increasing the energy density. This technology does this by allowing the use of lithium metal anodes through a liquefied gas electrolyte. The developed battery technology will serve as an ideal flexible solution for both grid storage batteries and electric vehicles.	1i, 2a, 3a, 3b, 3h, 4a, 5d, 5e	South 8 is currently in the design phase of their scaled-up system. A key area of development is designing the equipment to accurately fill cells with the proprietary electrolyte. Current testing is being done on their gas delivery, injection, and sealing system; the team expects to continue testing componentry until the end of quarter two of 2020.
EPC-18-021 ** Production Scale-Up for Next Generation Batteries Using Liquefied Gas Electrolytes	Pre-existing intellectual property identified in agreement EPC-18-021 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	South 8 Technologies	Group 3: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	This technology is advancing alternatives to Li-ion batteries that increase the safety of energy storage while also increasing the energy density. This technology does this by allowing the use of lithium metal anodes through a liquefied gas electrolyte. The developed battery technology will serve as an ideal flexible solution for both grid storage batteries and electric vehicles.	1i, 2a, 3a, 3b, 3h, 4a, 5d, 5e	South 8 is currently in the design phase of their scaled-up system. A key area of development is designing the equipment to accurately fill cells with the proprietary electrolyte. Current testing is being done on their gas delivery, injection, and sealing system; the team expects to continue testing componentry until the end of quarter two of 2020.

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2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-022 Advanced Energy Storage for Electric Vehicle Charging Support	Technology Demonstration and Deployment	For this project, Natron will produce an energy storage system (ESS) based on its new Prussian Blue/Sodium Ion (PB/Na-ion) battery technology, UCSD will perform on-grid performance validation of the ESS, and an existing publicly accessible EVgo EVFC station will be upgraded with a new ESS, inverter, and energy management software (EMS). This project will result in a cost-competitive alternative to Li-ion batteries that offers superior performance for high power / short-duration dispatch and long cycle life applications such as EVFC, frequency regulation, and grid stability during short-term utility and ISO outages. Natron will advance the battery manufacturing and product design of the ESS to Technology Readiness Level 8, enabling prompt commercial sales of PB ESS systems into the EVFC market.	6/12/2019	Yes	Grid Operations/ Market Design	$2,998,064	$2,998,064	$0	N/A	$0	$96,753	$0	Natron Energy, Inc.	$1,239,515	29.3%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-023 Utility Demonstration of Non-Flammable, Aqueous-Zinc Battery Storage: Innovation Scale-Up to Alleviate T&D Congestion and Mitigate Wildfire Risks	Technology Demonstration and Deployment	This project will demonstrate and deploy a scale up of a Generation 3 zinc hybrid cathode battery storage system at San Diego Gas and Electric's facility in Pala, San Diego County. The project will demonstrate the system's improved power and energy density by more than 25% over the previous Generation 2 system, and help commercialize an advanced, non-lithium-ion battery storage solution to help lower costs, improve safety, and provide greater electricity reliability for ratepayers.	6/12/2019	Yes	Grid Operations/ Market Design	$2,986,110	$2,986,110	$0	N/A	$0	$0	$0	Eos Energy Storage, LLC; TBD - Contractor; First Priority GreenFleet	$3,122,852	51.1%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-024 ** Large-Scale Sulfur Thermal Battery Demonstration for Enhanced Grid Flexibility and Increased Renewable Penetration	Technology Demonstration and Deployment	Element 16's sulfur thermal battery provides a low-cost solution to store and deliver high quality thermal energy due to its low cost, simple chemical composition, high heat transfer rates, and little to no need for any electrical heat tracing due to its low freezing point (~239 Fahrenheit), which guarantees low parasitic load and low O&M cost. The proposed project demonstrates sulfur thermal energy storage technology for electricity storage and generation, thus establishing new paradigms for increasing stored energy capacity and providing new forms of stationary electricity storage systems. With the potential to drastically reduce the levelized cost of electricity.	6/12/2019	Yes	Generation	$262,119	$262,119	$178,777	N/A	$178,777	$430,000	$0	Element 16 Technologies, Inc; Brad Alan LLC.	$640,000	17.6%	Grant

Project Name	Intellectual Property	Identification of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applicable Metrics	Update
EPC-18-022 Advanced Energy Storage for Electric Vehicle Charging Support	Pre-existing intellectual property identified in agreement EPC-18-022 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	7 out of 8 bidders	Natron Energy, Inc.	Ranked # 1	N/A	N/A	Yes; Calif Based Entity	The proposed project will generate greater market competition by creating a superior alternative to Li-ion batteries for the EVFC market, accelerating EVFC station buildouts, and thus supporting progress towards California's GHG (AB 32, Exec. Order B-30-15), energy storage (AB 2514, AB 2868) and vehicle and rideshare electrification (SB 1014) goals.	2a, 3f, 5b	The project kickoff meeting was held in October 2019. Natron is in the beginning stages of product design for the battery energy storage system.
EPC-18-023 Utility Demonstration of Non-Flammable, Aqueous-Zinc Battery Storage: Innovation Scale-Up to Alleviate T&D Congestion and Mitigate Wildfire Risks	Pre-existing intellectual property identified in agreement EPC-18-023 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	7 out of 8 bidders	Eos Energy Storage, LLC	Ranked # 2	N/A	N/A	No	The project will demonstrate the application and benefits of a cost-effective and efficient non-lithium-ion energy storage solution to help with load shifting, reduction in grid congestion, and deployment of renewable energy resources to help the state meet its energy goals.	2a, 5a, 5d	The energy storage system was delivered to San Diego Gas and Electric's Pala facility in December 2019. Installation, commissioning, and testing are now underway.
EPC-18-024 ** Large-Scale Sulfur Thermal Battery Demonstration for Enhanced Grid Flexibility and Increased Renewable Penetration	Pre-existing intellectual property identified in agreement EPC-18-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	7 out of 8 bidders	Element 16 Technologies, Inc	Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The development of this project will enhance grid resiliency, support the transmission and distribution infrastructure, and will provide low-cost, long-duration electric storage capacity to the CA grid. Electrically charging the low-cost sulfur thermal battery gives rise to system flexibility with respect to coupling to different types of energy sources and will drive the expansion of intermittent renewable sources such as wind and solar in California. The installation of low-cost sulfur thermal battery systems provides a financial benefit in the upcoming carbon market scenarios due to reduced levelized cost of electric storage, enables delivery of electricity at peak price periods, provides long-lasting backup power in the event of power outages during storm, etc., and substantially increases overall customer plant revenue.	1e, 1f, 3a	The project kick-off meeting was held on August 13, 2019. The project team is creating computational models to simulate the performance of the energy storage system for design/cost optimization.

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2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-024 ** Large-Scale Sulfur Thermal Battery Demonstration for Enhanced Grid Flexibility and Increased Renewable Penetration	Technology Demonstration and Deployment	Element 16's sulfur thermal battery provides a low-cost solution to store and deliver high quality thermal energy due to its low cost, simple chemical composition, high heat transfer rates, and little to no need for any electrical heat tracing due to its low freezing point (~239 Fahrenheit), which guarantees low parasitic load and low O&M cost. The proposed project demonstrates sulfur thermal energy storage technology for electricity storage and generation, thus establishing new paradigms for increasing stored energy capacity and providing new forms of stationary electricity storage systems. With the potential to drastically reduce the levelized cost of electricity.	6/12/2019	Yes	Generation	$2,737,881	$2,737,881	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-025 Scale-up of Magnetocaloric Materials for High Efficiency Magnetic Refrigeration	Market Facilitation	General Engineering Research's (GE&R) has developed MCE compositions that meet both the performance and cost requirements to be compatible with large scale implementation of magnetic refrigeration systems. For this project, GE&R will develop the processing systems to manufacture their MCE materials in forms needed for integration into magnetic refrigeration systems (spheres and thin plates). Equipment with 1kg or larger batch processing will be installed to accommodate 1kg/day low-rate initial production. Production at this scale will allow for end users to develop and test magnetic refrigeration prototypes, and ultimately move these systems into production.	6/12/2019	Yes	Distribution	$1,088,188	$1,088,188	$115,034	N/A	$115,034	$409,462	$0	Pacific Northwest National Laboratory; General Engineering & Research, L.L.C.	$306,791	22.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-18-026 ** Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency	Applied Research and Development	The project is advancing wildfire science by incorporating the interaction of tree mortality and extreme fire weather into next-generation fire models. The project is developing zero-to-seven-day risk forecasts for the grid with predictive capabilities, with computational efficiency and scalability. To support planning, the team is developing long-term fire projections using a coupled fire-climate-vegetation statistical and dynamical model to integrate the latest climate projections, tree mortality, development in the wildland-urban interface, and adaptation strategies. To integrate the models into electric utility management and planning, the team is facilitating workshops with IOUs. To support the Fifth Climate Assessment, the team is developing a web-based scenario analysis tool to visualize and explore the impacts of climate change and adaptation strategies on the grid.	6/12/2019	Yes	Distribution	$4,021,416	$4,021,416	$70,710	N/A	$70,710	$546,431	$0	The Brattle Group; Eagle Rock Analytics; US Geological Society (USGS); Spatial Informatics Group, LLC; Reax Engineering Inc.; University Corporation for Atmospheric Research ; Missoula Fire Sciences Laboratory; Pyrologix, LLC	$1,656,600	24.9%	Grant

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EPC-18-024 ** Large-Scale Sulfur Thermal Battery Demonstration for Enhanced Grid Flexibility and Increased Renewable Penetration	Pre-existing intellectual property identified in agreement EPC-18-024 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	7 out of 8 bidders	Element 16 Technologies, Inc	Ranked # 3	N/A	N/A	Yes; Calif Based Entity	The development of this project will enhance grid resiliency, support the transmission and distribution infrastructure, and will provide low-cost, long-duration electric storage capacity to the CA grid. Electrically charging the low-cost sulfur thermal battery gives rise to system flexibility with respect to coupling to different types of energy sources and will drive the expansion of intermittent renewable sources such as wind and solar in California. The installation of low-cost sulfur thermal battery systems provides a financial benefit in the upcoming carbon market scenarios due to reduced levelized cost of electric storage, enables delivery of electricity at peak price periods, provides long-lasting backup power in the event of power outages during storm, etc., and substantially increases overall customer plant revenue.	1e, 1f, 3a	The project kick-off meeting was held on August 13, 2019. The project team is creating computational models to simulate the performance of the energy storage system for design/cost optimization.
EPC-18-025 Scale-up of Magnetocaloric Materials for High Efficiency Magnetic Refrigeration	Pre-existing intellectual property identified in agreement EPC-18-025 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	28 out of 31 bidders	General Engineering & Research, L.L.C.	Group 1: Ranked # 1	N/A	N/A	Yes; Calif Based Entity	This project will help facilitate further development and deployment of magnetic refrigeration systems, which offer significant efficiency improvements over traditional vapor compression cooling systems while using no hydrofluorocarbons. Increased use of magnetic refrigeration can lead to lower energy use and GHG emissions.	2a, 3c, 3f, 3h, 4a	This project kicked-off in August 2019. For the remainder of the year, the project team acquired the necessary equipment to begin testing of various methodologies for production of the MCE including characterization of compositions of new alloys. The testing is used to determine if phase separation or compositional variation occurs during the production process. In 2020 the project team will move towards finalizing the MCE material composition and move towards higher volume production.
EPC-18-026 ** Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency	Pre-existing intellectual property identified in agreement EPC-18-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	9 out of 9 bidders	Spatial Informatics Group, LLC	Ranked # 1	N/A	N/A	Yes; Micro Business, Calif Based Entity	The project will aid regulators and stakeholders in meeting statutory goals by addressing critical fire science gaps and applying the science to provide advanced forecasting capability. Specifically, the project will: 1) advance the science of measuring, modeling, and analyzing extreme weather events, tree mortality, and fire spread at scale; 2) advance risk modeling frameworks to include wind extrema, statewide maps of fuel loads, updated parameterizations, and indicators of where risk forecasting may underestimate fire risk due to gaps in science; and 3) advance the integration of science relating to vegetation dynamics, the wildland-urban interface, land-use, climate, and adaptation strategies, by building on existing models and comparing approaches.	3a, 3b, 3c, 4a, 4b, 5a	The project kick-off meeting was in July 2019. The research team began assembling the project Technical Advisory Committee and initiating coordination among the project working groups. The research team also developed a plan for siting, installing, and operating a wind profiler to better understand how observed wind data can be used by utilities to improve short-term (up to 15 hours) and very-short-term (from 0 to 3 hours) extreme wind forecasts and enhance situational awareness during high-wind events.

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2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-18-026 ** Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency	Applied Research and Development	The project is advancing wildfire science by incorporating the interaction of tree mortality and extreme fire weather into next-generation fire models. The project is developing zero-to-seven-day risk forecasts for the grid with predictive capabilities, with computational efficiency and scalability. To support planning, the team is developing long-term fire projections using a coupled fire-climate-vegetation statistical and dynamical model to integrate the latest climate projections, tree mortality, development in the wildland-urban interface, and adaptation strategies. To integrate the models into electric utility management and planning, the team is facilitating workshops with IOUs. To support the Fifth Climate Assessment, the team is developing a web-based scenario analysis tool to visualize and explore the impacts of climate change and adaptation strategies on the grid.	6/12/2019	Yes	Distribution	$978,584	$978,584	$0	N/A	$0	$0	$0	None	$0	0.0%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-19-001 Reflex Flow Battery at Farm ACW	Technology Demonstration and Deployment	This project will entail the deployment of an advanced vanadium redox flow battery, and the other elements to create a 1.4 MW/5.6 MWh AC Energy Storage System (ESS) at Farm ACW's farm. The project will prove the scalability, the integration requirements, the reliability and the bankability of UET's newest high-performing battery product, the Reflex. The 1.5 MW, 5.6 MWh system will consist of roughly 195 Reflex modules connected in 15 strings. For Farm ACW, the system will provide peak shaving and increased Critical Peak Pricing (CPP) participation, to help save on their electric bill. In addition, the system will island, to create a microgrid during outages. For SDG&E, the system will provide the voltage support at a remote feeder and solar energy time shifting. By time shifting the solar energy from the peak solar output, to the later peak hours, the system will provide value in excess of what Farm receives.	8/14/2019	Yes	Generation	$2,969,998	$2,969,998	$0	N/A	$0	$0	$0	UniEnergy Technologies, LLC; Farm Acw	$1,965,856	39.8%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-19-002 "Smart Greenhouse": Integrated Photovoltaics/Photosynthesis for Energy and Food	Applied Research and Development	This project will improve the understanding of materials science and manufacturing approaches for transparent organic photovoltaic (TOPV) materials with conversion efficiency of 15 percent and average visible light transmittance of 30 percent. Moreover, the manufactured TOPV will be installed in a “smart greenhouse”; and tested to assess their efficiency, transmittance, stability, reliability, and also their effect on plant growth.	9/11/2019	Yes	Generation	$600,000	$600,000	$0	N/A	$0	$0	$0	The Regents of the University of California, Los Angeles	$60,000	9.1%	Grant

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EPC-18-026 ** Comprehensive Open Source Development of Next Generation Wildfire Models for Grid Resiliency	Pre-existing intellectual property identified in agreement EPC-18-026 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	9 out of 9 bidders	Spatial Informatics Group, LLC	Ranked # 1	N/A	N/A	Yes; Micro Business, Calif Based Entity	The project will aid regulators and stakeholders in meeting statutory goals by addressing critical fire science gaps and applying the science to provide advanced forecasting capability. Specifically, the project will: 1) advance the science of measuring, modeling, and analyzing extreme weather events, tree mortality, and fire spread at scale; 2) advance risk modeling frameworks to include wind extrema, statewide maps of fuel loads, updated parameterizations, and indicators of where risk forecasting may underestimate fire risk due to gaps in science; and 3) advance the integration of science relating to vegetation dynamics, the wildland-urban interface, land-use, climate, and adaptation strategies, by building on existing models and comparing approaches.	3a, 3b, 3c, 4a, 4b, 5a	The project kick-off meeting was in July 2019. The research team began assembling the project Technical Advisory Committee and initiating coordination among the project working groups. The research team also developed a plan for siting, installing, and operating a wind profiler to better understand how observed wind data can be used by utilities to improve short-term (up to 15 hours) and very-short-term (from 0 to 3 hours) extreme wind forecasts and enhance situational awareness during high-wind events.
EPC-19-001 Reflex Flow Battery at Farm ACW	Pre-existing intellectual property identified in agreement EPC-19-001 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	7 out of 8 bidders	UniEnergy Technologies, LLC	Ranked # 4	N/A	N/A	Yes; Calif Based Entity	The development of this project will enhance grid resiliency, support the transmission and distribution infrastructure, and will provide low-cost, long-duration electric storage capacity to the California grid. The integration of the advanced vanadium flow battery system and the Power Conversion System (PCS) and peak power controller will provide a working solution for the California market and grid. The design and permitting of the storage system will provide customers and developers working in California with credible operational data, credible budgetary data and a credible pro-forma design.	1e, 1f, 1h, 4a, 5a, 5d	The project kick-off was held in October 2019. The project team modified the design of the flow battery system and Underwriter Laboratories began testing the system for certification. However, the project is under a stop-work order due to an issue on funds spent in California.
EPC-19-002 "Smart Greenhouse": Integrated Photovoltaics/Photosynthesis for Energy and Food	Pre-existing intellectual property identified in agreement EPC-19-002 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 7 bidders	University of California, Los Angeles	Ranked # 3	N/A	N/A	No	Development of innovative transparent photovoltaic technologies that can be integrated in buildings, will help to achieve California's renewable energy generation goal and statewide requirement for all new buildings to have solar photovoltaic installed on the new constructions, even where the rooftop space is constrained.	1f, 2a, 3a, 3g, 4a, 4c	The agreement was approved at the September 2019 Business Meeting and is awaiting final approvals from all parties. The project kick-off is planned for early 2020.

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2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-19-003 Processing and Architecture Design to Develop and Demonstrate Stable and Efficient Perovskite + Silicon Tandem Modules	Applied Research and Development	This project will develop scalable processing of perovskite photovoltaic layers through spray deposition and rapid thermal annealing to fabricate and test 6x6 inch perovskite/silicon tandem devices with 25% cell efficiency.	9/11/2019	Yes	Generation	$999,802	$999,802	$0	N/A	$0	$161,295	$0	Tandem PV, Inc.	$999,986	50.0%	Grant
2018-2020 EPIC Program 3rd Triennial Investment	CEC	EPC-19-004 High-Efficiency Perovskite Tandem Modules with Resilient Interfaces	Applied Research and Development	The purpose of this Agreement is to develop robust, high-power perovskite-on-silicon tandem photovoltaic (PV) modules that achieve a power conversion efficiency of greater than 32% using low-cost manufacturing approaches. The perovskite top cell will be deposited on textured silicon cells, increasing energy production by 30% when the sun is near the horizon, reducing the ramp rate necessary for other grid participants, and improving reliability at future high PV penetration that is under statutory mandate.	9/11/2019	Yes	Grid Operations/ Market Design	$993,458	$993,458	$0	N/A	$0	$103,945	$0	The Regents of the University of California, San Diego; D2Solar LLC	$659,295	39.9%	Grant
			Active, Completed, and Terminated as of Dec 31, 2019					**$720,202,003**	**$720,202,003**	**$363,642,815**	**$0**	**$363,642,815**	**$137,780,451**	**$145,822,870**		**$385,341,558**		

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EPC-19-003 Processing and Architecture Design to Develop and Demonstrate Stable and Efficient Perovskite + Silicon Tandem Modules	Pre-existing intellectual property identified in agreement EPC-19-003 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 7 bidders	Tandem PV, Inc.	Ranked # 1	N/A	N/A	Yes; Calif Based Entity	Lower cost and higher power density solar through higher-efficiency and lower cost solar panels.	1c, 2a, 3b, 4a, 5a	The project kicked off in November 2019. During the next quarter, the research team will purchase equipment to set up a pilot manufacturing line at the company's facilities and hire additional technical personnel.
EPC-19-004 High-Efficiency Perovskite Tandem Modules with Resilient Interfaces	Pre-existing intellectual property identified in agreement EPC-19-004 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	5 out of 7 bidders	The Regents of the University of California, San Diego	Ranked # 2	N/A	N/A	Yes; Calif Based Entity	Perovskite-on-silicon tandem PV modules seek to achieve a power conversion efficiency of greater than 32% during the project period using low-cost manufacturing approaches that can scale to square meter (m2) products with a projected levelized cost of electricity of $0.031 per kilowatt-hour ($/kWh). These modules will incorporate optimized light-trapping and anti-reflection approaches to collect sunlight at wide angles, increasing energy production in the early morning and late evening to facilitate flattening of the duck curve.	1f, 2a, 4a	The agreement was approved at the September 2019 Business Meeting and is awaiting final approvals from all parties. The project kick-off is planned for early 2020.

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			Canceled and Terminated Projects with no Funds Spent - Not Included in the Project Count or Amount. ******															
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-14-020 Pilot testing and demonstration of a solar hybrid system with advanced storage and low temperature turbine to produce on-demand solar electricity	Applied Research and Development	The project's use of combined PV and thermal energy with an organic Rankine cycle is radical and as such, is outside the scope of the rich incentive programs for conventional technologies. While the costs offered by large-volume deployments will offer an LCOE competitive with grid-purchased electricity, the significant non-recurring one-time engineering expenses involved in technology integration, deployment and optimization work do not make this a possibility today.	4/8/2015	No	Distribution	$2,530,952	$2,530,952	$0	N/A	$0	$792,667	$0	None	$2,350,650	48.2%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-011 Isothermal Compressed Air Energy Storage with Solar and Load Forecasting Integration	Applied Research and Development	LightSail Energy, along with its partner, the University of California San Diego (UCSD), was to design build, operate, monitor, and analyze an I-CAES system on the Eliot Field PV station owned by UCSD. The energy storage system was to be a pilot unit for testing the capabilities and performance potential of I-CAES for load following and ancillary services, as well as renewable integration. The project was to also gather data needed to reduce the cost of I-CAES, increase its efficiency, and support its incorporation into the California electric grid. The installed energy storage system was to be capable of charging from both the installed PV on site and the electric grid (operated by SDG&E) and was to be capable of 200kW of discharging power and was to store up 800kWh of energy.	12/9/2015	No	Distribution	$1,200,276	$1,200,276	$0	N/A	$0	$102,846	$0	LightSail Energy	$779,400	39.4%	Grant

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EPC-14-020 Pilot testing and demonstration of a solar hybrid system with advanced storage and low temperature turbine to produce on-demand solar electricity	Pre-existing intellectual property identified in agreement EPC-14-020 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	Cogenra Solar, Inc.	Group 2: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	N/A	N/A	This project was approved at an Energy Commission Business Meeting, but later canceled by the recipient; however, no work was done on these projects and no EPIC funds were spent.
EPC-15-011 Isothermal Compressed Air Energy Storage with Solar and Load Forecasting Integration	Pre-existing intellectual property identified in agreement EPC-15-011 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	LightSail Energy	Group 2: Ranked # 5	N/A	N/A	Yes; Calif Based Entity	N/A	N/A	This project was approved at an Energy Commission Business Meeting, but later terminated by the recipient; however, no work was done on these projects and no EPIC funds were spent.

Invest-ment Program Period	Program Admin-istrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immed-iately prior calendar year?	Assign-ment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date: Contract/ Grant Amount ($)	Funds Expended to date: In house expend-itures ($) *****	Funds Expended to date: Total Spent to date ($)	Admin-istrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-014 Advanced Hybrid Battery-Fuel Cell Energy Storage System	Applied Research and Development	To account for the increasing demand for energy storage and shifting energy market, the Recipient was to develop a hybrid battery-fuel cell (B-FC) energy storage system for rapid response and modular design with flexible capacity for distributed energy reserve. The integration between battery and fuel cell partitions enables the system to store excess electricity from the grid as both battery power, plus chemical power in the form of hydrogen gas. The hydrogen is supplied by a waste-derived source (not electrolyzers). The system can then dispatch the stored power through the ultra-rapid response of the battery, and the load-following fuel cell using the stored hydrogen. The waste-derived dilute hydrogen coupled with battery storage promises >80% cycle efficiency and to meet the Energy Commission's cost goals. The B-FC system can provide clean, green, on-demand, rapid response power with no emissions or environmental impact.	1/13/2016	No	Demand-side Management	$1,199,975	$1,199,975	$0	N/A	$0	$406,835	$0	None	$1,169,580	49.4%	Grant
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-017 Utilizing Waste Heat to Increase Efficiency of Isothermal Compressed Air Energy Storage in a Smart Microgrid Environment	Applied Research and Development	LightSail Energy was to install and pilot test a 200kW I-CAES system at the UCI campus in Irvine California. The storage unit was to be operated in conjunction with UCI's 1,000kW solar PV array and 300kW advanced natural gas turbine, all interconnected through an advanced "smart" microgrid. The I-CAES system was to use waste heat from the gas turbine to increase round-trip efficiency. This is possible because I-CAES uses large water tanks as thermal storage, capturing and storing the heat of compression for use when the system is expanding air and producing electricity. The waste heat from the gas turbine was to be captured and stored in the I-CAES thermal storage tanks and later converted into electricity. This project was to provide the state's first real-world data on the operation and performance of an isothermal compressed air energy storage system and its ability to utilize waste heat for increased efficiency.	1/13/2016	No	Grid Operations/Market Design	$1,085,125	$1,085,125	$0	N/A	$0	$89,979	$0	LightSail Energy	$811,645	42.8%	Grant

Project Name	Intellectual Property	Identifi-cation of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applic-able Metrics	Update
EPC-15-014 Advanced Hybrid Battery-Fuel Cell Energy Storage System	Pre-existing intellectual property identified in agreement PON-13-302-27 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	FuelCell Energy, Inc.	Group 2: Ranked # 8	N/A	N/A	Yes; Calif Based Entity	N/A	N/A	This project was approved at an Energy Commission Business Meeting, but later canceled by the recipient; however, no work was done on these projects and no EPIC funds were spent.
EPC-15-017 Utilizing Waste Heat to Increase Efficiency of Isothermal Compressed Air Energy Storage in a Smart Microgrid Environment	Pre-existing intellectual property identified in agreement EPC-15-017 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	35 out of 38 bidders	LightSail Energy	Group 2: Ranked # 6	N/A	N/A	Yes; Calif Based Entity	N/A	N/A	This project was approved at an Energy Commission Business Meeting, but later terminated by the recipient; however, no work was done on these projects and no EPIC funds were spent.

Invest-ment Program Period	Program Admin-istrator	Project Name	Project Type	A brief description of the project	Date of the award	Was this project awarded in the immed-iately prior calendar year?	Assign-ment to Value Chain	Encumbered Funding Amount ($)	Committed Funding Amount ($)	Funds Expended to date: Contract/ Grant Amount ($)	Funds Expended to date: In house expend-itures ($) *****	Funds Expended to date: Total Spent to date ($)	Admin-istrative and overhead costs to be incurred for each project	Leveraged Funds	Partners	Match Funding	Match Funding Split	Funding Mechanism
2012-2014 EPIC Program 1st Triennial Investment Plan	CEC	EPC-15-052 ZipPower San Leandro	Market Facilitation	This project was to develop and pilot a platform that optimizes distributed energy resource planning by integrating and automating all the data required to target optimal sites across city areas, and streamline pre-approval of the permitting and interconnection at those sites. The project was also to use aggregated customer financing as an option to design, finance, deploy, scale, and replicate Advanced Energy Communities.	5/17/2016	No	Demand-side Management	$1,495,338	$1,495,338	$0	N/A	$0	$158,370	$0	ZipPower, LLC	$486,000	24.5%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-060 Adaptive Chargers for Delivery Customers Demonstrating California Advances in Charging	Technology Demonstration and Deployment	Motiv Power Systems was to develop both a smart charger solution and a bi-directional charger solution to enable vehicle-grid integration (VGI) with electric fleet vehicles. This technology was to be demonstrated with AmeriPride Services delivery trucks in Fresno, Bakersfield, Merced, and Stockton. Motiv was to develop both a software-only smart charger solution as well as a bi-directional on-board charger solution for vehicles that can be easily purchased as an option for installation on existing vehicles. This solution was to fit within a scalable and modular powertrain already used in a variety of vehicle applications, thus allowing VGI solutions to fit within a variety of emerging markets and be supplied to vehicle builders from a variety of delivery trucks, work trucks, shuttle buses, and school buses. This was to allow VGI to fit both within goods movement and freight plans as well as clean transit and zero-emission bus plans.	5/10/2017	No	Demand-side Management	$4,529,956	$4,529,956	$0	N/A	$0	$818,672	$0	Motiv Power Systems, Inc.	$1,513,524	25.0%	Grant
2015-2017 EPIC Program 2nd Triennial Investment Plan	CEC	EPC-16-069 Demonstrate the Phase III functions of a PV smart inverter and a storage inverter.	Applied Research and Development	Demonstrate the eight phase III functions of smart inverters in the field. This project was to test and validate the Phase III functions of a PV smart inverter and a storage inverter to support higher penetrations of solar on the feeder to the South Coast AQMD Headquarters in Diamond Bar, California. This project was to test, validate, and demonstrate all eight Smart Inverter Working Group (SIWG) Phase III functions in a system composed of a PV smart inverter, a bi-directional storage inverter, using behind-the-meter solar and storage. This was to increase circuit hosting capacity for solar and decrease distributed PV integration costs.	6/14/2017	No	Distribution	$2,729,943	$2,729,943	$0	N/A	$0	$594,333	$0	South Coast Air Quality Management District; Advanced Microgrid Solutions, Inc.; Nemaste Solar	$2,173,382	44.3%	Grant
			Canceled and Terminated with No Funds Spent as of Dec 31, 2019					**$14,771,565**	**$14,771,565**	**$0**		**$0**	**$2,963,702**	**$0**		**$9,284,181**		

Project Name	Intellectual Property	Identifi-cation of the method used to grant awards	If competitively selected, provide the number of bidders passing the initial pass/fail screening for project	If competitively selected, provide the name of selected bidder	If competitively selected, provide the rank of the selected bidder in the selection process	If competitively selected, explain why the bidder was not the highest scoring bidder, explain why a lower scoring bidder was selected	If interagency or sole source agreement, specify date of notification to the Joint Legislative Budget Committee (JLBC) was notified and date of JLBC authorization *	Does the recipient for this award identify as a California-based entity, small business, or businesses owned by women, minorities, or disabled veterans?	How the project leads to technological advancement or breakthroughs to overcome barriers to achieving the state's statutory energy goals	Applic-able Metrics	Update
EPC-15-052 ZipPower San Leandro	Pre-existing intellectual property identified in agreement EPC-15-052 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	27 out of 28 bidders	ZipPower, LLC	Group 1: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	N/A	N/A	This project was approved at an Energy Commission Business Meeting, but later terminated by the recipient; however, no work was done on these projects and no EPIC funds were spent.
EPC-16-060 Adaptive Chargers for Delivery Customers Demonstrating California Advances in Charging	Pre-existing intellectual property identified in agreement EPC-16-060 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	29 out of 31 bidders	Motiv Power Systems, Inc.	Group 4: Ranked # 2	N/A	N/A	Yes; Calif Based Entity	N/A	N/A	This project was approved at an Energy Commission Business Meeting, but later terminated by the recipient; however, no work was done on these projects and no EPIC funds were spent.
EPC-16-069 Demonstrate the Phase III functions of a PV smart inverter and a storage inverter.	Pre-existing intellectual property identified in agreement EPC-16-069 (Confidential Products and Pre-Existing Intellectual Property Lists, Attachment C-2) will reside with the recipient. New intellectual property developed under this agreement will be subject to the agreement Terms and Conditions.	Competitive	31 out of 35 bidders	Advanced Microgrid Solutions, Inc.	Group 4: Ranked # 2	N/A	N/A	Yes; Calif Based Entity, Woman Own	N/A	N/A	This project was approved at an Energy Commission Business Meeting, but later terminated by the recipient; however, no work was done on these projects and no EPIC funds were spent.

Appendix C Notes: Electric Program Investment Plan Project Status Report

* Pursuant to Public Resources Code section 25711.5(h)(2) the Energy Commission may use a sole source or interagency agreement if it notifies JLBC at least 60 days prior to making the award and JLBC either approves or does not disapprove within 60 days following the notification. Following Energy Commission notification, JLBC approved or did not disapprove all Energy Commission sole source or interagency agreements and they were deemed authorized after 60 days.

** Projects include funds from EPIC Plan 2012-2014 and EPIC Plan 2015-2017 or EPIC Plan 2015-2017 and EPIC Plan 2018-2020, or more than one investment area. There is a total of 332 projects.

*** Project EPC-17-042 changed prime recipient from ICF Incorporated, L.L.C. to Camptonville Community Partnership, Inc.

**** The federal cost share solicitation was on-going and funds were awarded to passing proposals on a first-come, first-served basis.

***** Funds Expended to date: In House Expenditures: Reporting of In-house Expenditures is required of the IOUs, but not the Energy Commission per CPUC D.13-11-025 page 51 and ordering paragraph 20.

****** Projects were approved at an Energy Commission Business Meeting, but later canceled or terminated by the recipient; however, no work was done on these projects and no EPIC funds were spent (Not included in project count and amount).

Note: Each amendment to a project with an adjustment to the EPIC encumbered funding amount is listed on a separate row.