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March 29, 2019

Ed Randolph
Director, Energy Division
California Public Utilities Commission
505 Van Ness Avenue
San Francisco, CA 94102

Re: A.11-03-001 et al- Southern California Edison Company's 2018 Semi-Annual Report on Demand Response Emerging Technologies Program

Dear Mr. Randolph:

In accordance with Decision 12-04-045, Ordering Paragraph 59, attached please find Southern California Edison (SCE) Company's semi-annual report. This report is also being served on the most recent service lists in Application 11-03-001 et al. and Rulemaking 13-09-011, and has been made available on SCE's website. The URL for the website is:

Go to www.sce.com;

- Click on the "Regulatory" Information link at the bottom of the page;
- Select "CPUC Open Proceedings";
- Enter "A.11-03-001" in the search box;
- Locate and select the "SCE Emerging Markets & Technology DR Projects 2018 Q3-Q4 Semi-Annual Report" link to access associated document.

If you have any questions, please feel free to contact me.

Sincerely,

/s/ Nathanael Gonzalez

Nathanael Gonzalez

cc: A.11-03-001 et al. Service List
R.13-09-011 Service List

Enclosure

Demand Response Emerging Markets and Technologies Program

Semi-Annual Report: Q3 – Q4 2018

Prepared by:
Southern California Edison (U-338-E)

March 2019

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Contents

Abbreviations and Acronyms

AC	Air Conditioning
ACEEE	American Council for an Energy-Efficient Economy
ADR	Automated Demand Response (aka Auto-DR)
AHRI	Air Conditioning, Heating, and Refrigeration Institute
AHU	Air-Handling Unit
AMI	Advanced Metering Infrastructure
ASHRAE	American Society of Heating and Air Conditioning Engineers
AT	Advanced Technology
BAN	Building Area Network
BBI	Better Buildings Initiative
BCD	Business Customer Division
BEMS	Building Energy Management System
BESS	Battery Energy Storage System
BOD	Biochemical Oxygen Demand
C&S	Codes and Standards
CAISO	California Independent System Operator
CALTCP	California Lighting Contractors Training Program
CASE	Codes and Standards Enhancement
CCS	Conditioned Crawl Spaces
CEC	California Energy Commission
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
CZ	Climate Zone
D.	Decision (CPUC)
DAC	Disadvantaged Community
DER	Distributed Energy Resource
DOE	Department of Energy
DR	Demand Response
DRAS	Demand Response Automated Server
DRLIMFH	Deep Retrofits in Low-Income Multi-Family Housing
DRMEC	Demand Response Measurement and Evaluation Committee
DRMS	Demand Response Management System
DRRC	Demand Response Research Center
DSM	Demand-Side Management
EDF	Environmental Defense Fund
EE	Energy Efficiency
EEC	Energy Education Center
EERP	Energy Efficient Retrofit Packages
EM&T	Emerging Markets & Technologies
EMCB	Energy Management Circuit Breaker
EMS	Energy Management System
EPA	Environmental Protection Agency
EPIC	Electric Program Investment Charge
EPRI	Electric Power Research Institute
ET	Emerging Technologies
ETCC	Emerging Technologies Coordinating Council
EVSE	Electric Vehicle Supply Equipment
EVTC	Electric Vehicle Test Center
EWH	Electric Water Heater
FDD	Fault Detection and Diagnostics

FERC	Federal Energy Regulatory Commission
GHG	Greenhouse Gas
GIWH	Grid Integrated Water Heater
GWP	Global Warming Potential
HAN	Home Area Network
HEMS	Home Energy Management System
HFC	Hydrofluorocarbons
HVAC	Heating, Ventilation, and Air Conditioning
IALD	International Association of Lighting Designers
IAQ	Indoor Air Quality
IDSM	Integrated Demand-Side Management
IESNA	Illuminating Engineering Society of North America
IoT	Internet of Things
IOU	Investor-Owned Utility
kW	kilowatt
kWh	kilowatt-hour
LBNL	Lawrence Berkeley National Laboratory
LEED	Leadership in Energy and Environmental Design
LIMF	Low-Income Multi-Family
M&V	Measurement and Verification
MF	Multi-Family
MSO	Meter Services Organization
MW	megawatt
NEEA	Northwest Energy Efficiency Alliance
NEM	Net Energy Metering
NG	Natural Gas
NPDL	New Product Development & Launch
NREL	National Renewables Energy Laboratory
NYSERDA	New York State Energy Research and Development Authority
OCST	Occupant-Controlled Smart Thermostat
OEMs	Original Equipment Manufacturers
OP	Ordering Paragraph
OpenADR	Open Automated Demand Response
OTE	Oxygen Transfer Efficiency
PC	Personal Computer
PCT	Programmable Communicating Thermostat
PDR	Proxy Demand Response
PEV	Plug-In Electric Vehicle
PLMA	Peak Load Management Alliance
PLS	Permanent Load Shift
PMS	Property Management System
PTR	Peak Time Rebate
PV	Photovoltaic
QI/QM	Quality Installation/Quality Maintenance
RESU	Residential Energy Storage Unit
RFI	Request for Information
RPS	Renewable Portfolio Standard
RSO	Revenue Services Organization
RTU	Rooftop Unit (air conditioning)
SCE	Southern California Edison
SEER	Seasonal Energy Efficiency Ratio
SEPA	Smart Electric Power Alliance
SGIP	Self-Generation Incentive Program
SME	Subject Matter Expert

SMUD	Sacramento Municipal Utility District
SONGS	San Onofre Nuclear Generating Station
T-24	Title 24 (California building energy efficiency code)
TES	Thermal Energy Storage
TOU	Time of Use
TTC	Technology Test Center
UCOP	University of California – Office of the President
UL	Underwriters Laboratories
USGBC	U.S. Green Building Council
VCAC	Variable-Capacity Air Conditioning
VCHP	Variable-Capacity Heat Pump
VCRTU	Variable-Capacity Roof Top Unit
VNEM	Virtual Net Energy Metering
VRF	Variable Refrigerant Flow
WW	Wastewater
WWTP	Wastewater Treatment Plant
ZNE	Zero Net Energy

1. Summary

Southern California Edison (SCE) submits this 2018 Q3-Q4 semi-annual report in compliance with Ordering Paragraph (OP) 59 of the California Public Utilities Commission (CPUC) Demand Response Decision (D.) 12-04-045 dated April 30, 2012. The subject Decision directed SCE to submit a semi-annual report regarding its demand response (DR) Emerging Markets and Technologies (EM&T) projects by March 31 and September 30 of each program year.

As described in SCE's 2018-2022 DR program application (A.17.01.012, et al) and ultimately approved in D.17-12-003, the SCE DR EM&T program facilitates the deployment of innovative new DR technologies, software, and system applications that may enable cost effective customer participation and performance in SCE's DR rates, programs, and market resources. DR is an important resource, not only for meeting the state's environmental goals, but also for providing SCE's customers an important tool to manage their energy usage and costs. SCE's DR EM&T program will continue to provide SCE customers advanced technology options for participating in DR programs, tariffs, and third party aggregators.

As part of its charter to advance the overall market adoption of demand response emerging technologies, SCE's EM&T program works collaboratively with the other California Investor-Owned Utilities (IOUs), coordinating statewide applied DR research with the Emerging Technology Coordinating Council (ETCC). The DR EM&T program also leverages the innovation activities from other organizations such as the California Energy Commission's EPIC program, national laboratories, and supports DR advocacy through standards organizations and public agencies.

In accordance with the CPUC direction for the reporting of the DR EM&T program, this report covers SCE DR EM&T project activities during the timeframes between July 1, 2018 and December 31, 2018, for Q3 and Q4 of program year 2018.

2. Projects Completed Q3 – Q4 2018

DR15.20 Dispatchable Condenser Air Pre-Cooler

Overview

Evaporative condenser air pre-coolers utilize evaporative cooling methods to pre-cool the inlet air to the condenser of an air conditioning system. This results in a lower inlet temperature for air conditioner heat rejection, reducing power demand and increasing air conditioning process efficiency. While significant work has been done in the past to demonstrate pre-coolers as an energy efficiency measure, this project studied the technology as a dispatchable demand response resource, controlled by the utility for grid management.

Example of Direct Evaporative Cooling of Condenser

This project was designed as a laboratory test and field study by the University of California at Davis to assess opportunities for DR with rooftop air conditioning systems. The research approach was to test the transient response of cooled inlet condenser air and its impact on improved compression-cycle efficiency and demand load profile reduction, specifically for providing DR reduction capabilities. This technology is also being considered in this study as a method of saving energy associated with air conditioning at part load conditions, reducing peak electricity demand, and permanently reducing electric load for DR "shape" strategies.

Collaboration

The key entity undertaking this project was the UC Davis Western Cooling Efficiency Center (WCEC). The Center is located at Davis, California, and SCE is a supporting partner of the overall research conducted at the WCEC. SCE is an affiliate of the WCEC along with many other Heating, Ventilation and Air Conditioning (HVAC) industry stakeholders, and SCE sponsored this project through its Emerging Products program portfolio.

Results/Status

The WCEC set up the prototype pre-cooler system in their laboratory at Davis to optimize the design of the pre-cooler system before field installation. The tests were completed in 2017, and the results were compiled in an interim memorandum to inform the field work scheduled for summer 2018. The data verified single-compressor rooftop unit (RTU) demand reduction after a pre-cooler is activated; however, signal delays were observed during testing resulting in slower response for some of the test locations. A review of the manufacturer's RTU literature was completed to investigate delays required to turn off compressors in multiple-compressor units.

The laboratory results illustrate that at steady-state operation, the technology can reduce demand quickly (within two minutes of pre-cooler dispatch) and can reduce power consumption by up to 25%. The WCEC then conducted the site selection of five pre-coolers on a "big box" retail store in Southern California, and instrumented the equipment with sensors to access vital performance indicators in the field. Preliminary results showed an average power reduction of 20% for the pre-cooled RTU, while yielding a coincident 10% increase in cooling capacity. Power reduction findings were 75% in one minute of DR signal dispatch, and 100% power reduction within 13 minutes of DR signal dispatch.

Next Steps

Findings from laboratory testing, manufacturer literature and the field testing resulted in a better understanding of how this system provides DR capabilities. SCE will next assess how to best incorporate this DR strategy for future program design. From this research, UC Davis has gained further knowledge in the operation, benefits, and strategies for Air-Handling Unit (AHU) pre-coolers. The technology has limited application due to the current RTU market in Southern California that does not deploy pre-coolers, but the research will be shared with the HVAC industry as a potential market transformation recommendation for future consideration by UC Davis and the Emerging Technology Coordinating Council (ETCC).

The final report was posted to the ETCC web site at:

https://www.etcc-ca.com/reports/characterizing-transient-and-aggregate-response-dispatchable-condenser-air-pre-coolers

DR17.04 Energy Management Circuit Breakers (EMCB)

Overview

SCE is one of twelve United States utilities that worked with the Electric Power Research Institute (EPRI) and Eaton Corporation to deploy and demonstrate an advanced Energy Management Circuit Breaker (EMCB). The overall project started in September of 2014 with SCE joining the project in October of 2016. The Phase 1 project closed out in August of 2018. Nearly 250 EMCB devices were deployed in the project across the twelve participating utilities, in 19 states at more than 60 sites around the US. The EMCB was a design concept initiated by EPRI researchers.

The project tested the ability of the new EMCB device to act as a "smart" circuit breaker, which could be installed as a retrofit to existing customer electrical load panels. The EMCB device could be used for embedded revenue–grade energy metering, including the ability to measure and report circuit level energy voltage, current and frequency (at 1-second intervals), a remotely controllable ON/OFF switch, and a Wi-Fi communications interface.

Phase 1 EMCB Devices

A major goal of the research was to understand the functionality and potential value propositions for various end-use device circuits currently in service on utility-owned use cases. The EMCB may prove to be a powerful device to manage distributed generation and storage, act as a remote disconnect, and as a monitoring and verification (M&V) device. The opportunities for cost effective load management and demand response capabilities with the EMCB were investigated as an opportunity to embed the communications technology in the electrical panel for remote control use cases and reduce program costs.

Collaboration

SCE participated in this project as a joint collaboration partner, with EPRI as the project lead and research coordinator. There were 11 other participating nationwide utilities that conducted field testing, with most support from:

- Duke Energy
- Southern Company
- CenterPoint Energy
- Tri-State Generation and Transmission Association
- PECO Energy
- Tennessee Valley Authority

In addition, EPRI tested the capability of the EMCB in their laboratory for accurately collecting and sharing data, receiving and sending controls signals to other smart equipment (such as thermostats and water heaters), and shifting residential on-grid and off-grid connections during emergencies.

Results/Status

The first phase of the EMCB project has been completed by EPRI, with all of the Phase 1 research partners. The DR use case and energy monitoring use case were tested at two locations within SCE's service territory where the EMCBs were installed. As this was a joint project with other utilities, EPRI received information from all of the test site results, and EPRI is now developing a Phase 2 project to improve upon the EMCB design and include more features for supporting additional applications such as electrical vehicle supply equipment (EVSE).

A final report summarizing the results from these use cases was completed by EPRI at the end of 2018. At this time the full report and project findings are only available to the utilities involved in the project as contributors. EPRI may provide a project summary for public review and database, and SCE will work with EPRI to provide additional information that can be shared with other stakeholders.

Next Steps

The overall Phase 1 EMCB project was considered a success by EPRI, the participating utilities, and the manufacturer Eaton, in terms of the device performance and opportunities for demand response. The manufacturer is now proceeding with UL certification and commercialization of the device. SCE will be sharing the findings internally with SCE stakeholders and will review the test results with EPRI and the project team in early 2019.

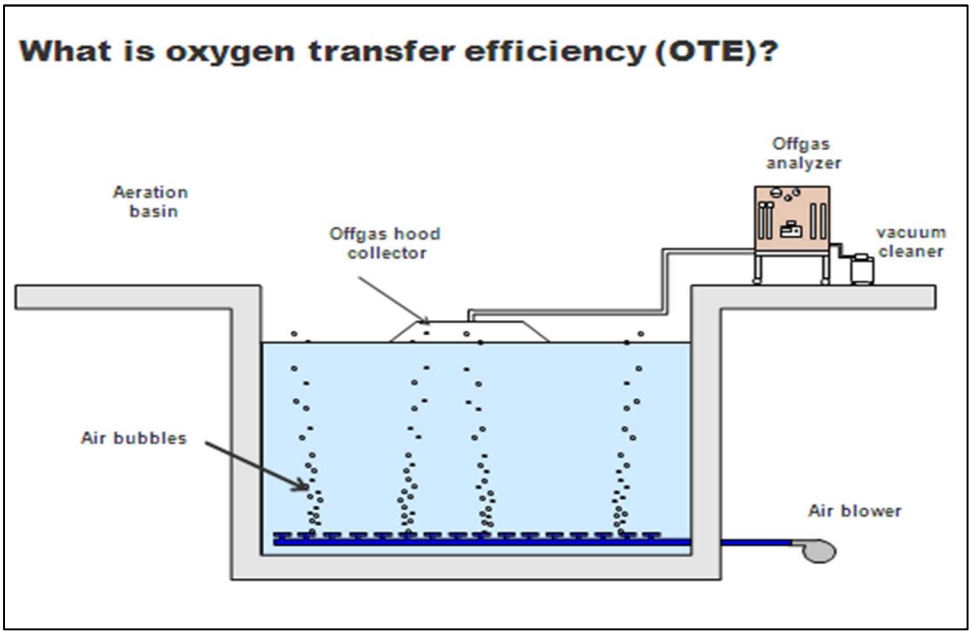
3. Projects Continued Q3 – Q4 2018

DR15.18 Wastewater Treatment Plant Demand Response

Overview

Wastewater (WW) treatment in the water industry is a critical process that is an energy-intensive and continuous industrial operation, subject to varying hourly surges that must be met in real time. Typical WW Treatment Plants (WWTPs) have limited capacity to delay or shift operations, and often cannot store incoming WW, prohibiting effective DR strategies that could otherwise be deployed. The enablement of WWTP DR strategies for local grid resiliency may require operational changes that could make use of emerging and innovative technologies.

Recent technological developments for energy efficiency have shown a significant reduction in electrical power for WWTPs, improving their plant operations. These are being leveraged as an opportunity for DR innovation. Aeration blowers, that can effectuate the process of oxygen transfer efficiency (OTE), are used as part of the secondary treatment stage (activated sludge). They may account for 50% of a plant's energy demand and usage and can be controlled through new technology to significantly reduce power requirements, making effective DR event responses possible.



Wastewater Aeration System

The Oxygen Transfer Efficiency (OTE) Analyzer is a key technology breakthrough. The OTE allows modifying the operational parameters of WWTPs to support DR events, while maintaining the WWTP permit process. The technology shows potential for DR event participation, supporting the EM&T and DR program drivers of providing greater grid security through energy load reduction on demand, and increasing EE through precision process control.

This project is testing several changes to a WW treatment facility's aeration operation to first enable and maximize overall energy savings and then facilitate DR capabilities and impacts. The goal of the DR testing is to find the optimum configuration that meets the DR objectives without compromising the process operations while providing the least impact to the plant's operation, with the highest influence on power demand reduction.

Project deliverables include:

- A report including methods, site data logs, results of DR effectiveness, and recommendations for future development and application.
- A permanent advanced OTE analyzer installed at the Chino, California WWTP site.

Collaboration

Multiple stakeholders have come together to provide support, helping to ensure project success though meaningful engagement:

- DrH2O, the prime contractor who developed the OTE Analyzer, responsible for all field work and technical expertise
- UC Irvine, supporting this work as a subcontractor to DrH2O
- SCE's field engineering staff, working with the DrH2O team supporting the field and technical work
- The Inland Empire Utility Authority (IEUA) WW facility in Chino, who provided the installation site

Results/Status

Telemetry data collection is ongoing, and final draft results will review how the overall strategy for managing WW operations can support the research strategy of providing on-demand energy load reduction through using the OTE analyzer for precision WWTP aeration system process control.

Preliminary findings are promising, and the future planned activities are:

1. The OTE analyzer has been fabricated, tested, and installed at the Inland Empire Utility Authority (IEUA) WW facility in Chino.
2. The data collection systems are operational, allowing the project team to gather preliminary data to assess the functionality of the off-gas analyzer and calibrate it accordingly.

3. The power demand interface will be developed, and at its completion, the actual WW plant power demand will be compared to the interface data.
4. The analyzer will continue to be tested, with upgrades and modifications as needed.
5. The data from 2018, along with new data, will continue to be analyzed.
6. Several changes were tested to the treatment facility's aeration operations to facilitate DR capabilities and impacts. Also examined other benefits including reduced maintenance and energy costs.

Next Steps

The test data are being analyzed by the team at UC Davis and the IEUA, and the final report with DR load impact results and recommendations is expected to be delivered in the first quarter of 2019 after one year of data is collected.

DR15.21 Mosaic Gardens Low-Income Multi-Family Housing

Overview

A large percentage of new residential construction in California is now Multi-Family (MF). Much of this development in new housing stock is targeting a long-overlooked segment: Low Income. As a result, State and Federal programs are providing incentives to encourage the development of new Low Income Multifamily (LIMF) residential construction projects. Some LIMF developers are also adopting high-efficiency measures combined with solar generation to enhance investment paybacks.

This project provides SCE with a real-time "in situ" opportunity to demonstrate how innovative Zero Net Energy (ZNE) measures can be effectively adopted in new LIMF construction. The knowledge gained will assist in understanding implementation barriers that can lead to greater adoption of ZNE in the LIMF sector. The goal of the project is to conduct a post-occupancy field test to evaluate the installation and operation of viable measures that could provide EE and DR capabilities in individual residential units and communities.

Mosaic Gardens Complex

Located in Pomona, California, Mosaic Gardens is a new three-story LIMF residential development consisting of forty-six apartment units constructed on an infill lot. The apartment units vary in size from one to three bedrooms. The community serves tenants that are low-income; half the units are designated for displaced residents.

Renewable energy generation technologies implemented at this development include a 34 kW of rooftop PV array, complimented by a grid-tied storage battery; both serving the common areas. The interaction of these systems is fundamental to attaining ZNE goals.

The project includes the demonstration of key DR features such as: smart communicating thermostats to reduce electricity demand in response to an Open ADR signal; grid-tied battery storage; and advanced building controls using Virtual Net Energy Metering (VNEM) to support grid stabilization. In addition, this project will explore the benefits of DR controls through wireless communicating thermostats and DER interaction. The technology is expected to provide improvements to LIMF community management, and improved tenant comfort while supporting low energy usage and costs.

Collaboration

Many stakeholders are collaborating in this multi-faceted project, ensuring success towards the project goals. The facility owner, LINC Housing, is a key stakeholder; demonstrating support as an early adopter of new technologies to the LIMF segment. The California Energy Commission is another important stakeholder; providing support to collect and analyze energy usage data that demonstrate the building system's performance.

SCE's stakeholders include the Emerging Products Group, the Savings by Design Group, and the Codes and Standards Group. Together, these stakeholders provided much support that included leveraging resources to investigate EE and DR opportunities, helping the owner identify measures that qualify for incentive payments, and providing SMEs to support the project throughout the design and construction process.

Results/Status

Building construction is complete and occupancy is 100% as of end of 2018; all building systems are in operation including the PV array. The battery storage system is installed but not yet online, but commissioning is completed and final interconnection permitting approval is pending. Construction best practices and cost data are identified and documented. The construction data are helping to support the development of a new MF Commercial Building Code.

Measurement and verification (M&V) equipment supporting end use of the data acquisition system (DAS) is operating and recording data after occupancy.

Next Steps

ZNE best practices are being continuously gathered and documented for assessing performance of the building to meet the overall intent of the ZNE design. Additional activities still in progress include the development of a ZNE operational profile for

the battery that was installed end of fourth quarter 2018, which will include a future test plan for demand response flexibility. Planned is the full commissioning of an energy information community dashboard indicating end-use energy data. There is also an apartment monitoring system that has been installed and is now expected to be fully commissioned by the end of Q1 2019 for further resident data collection.

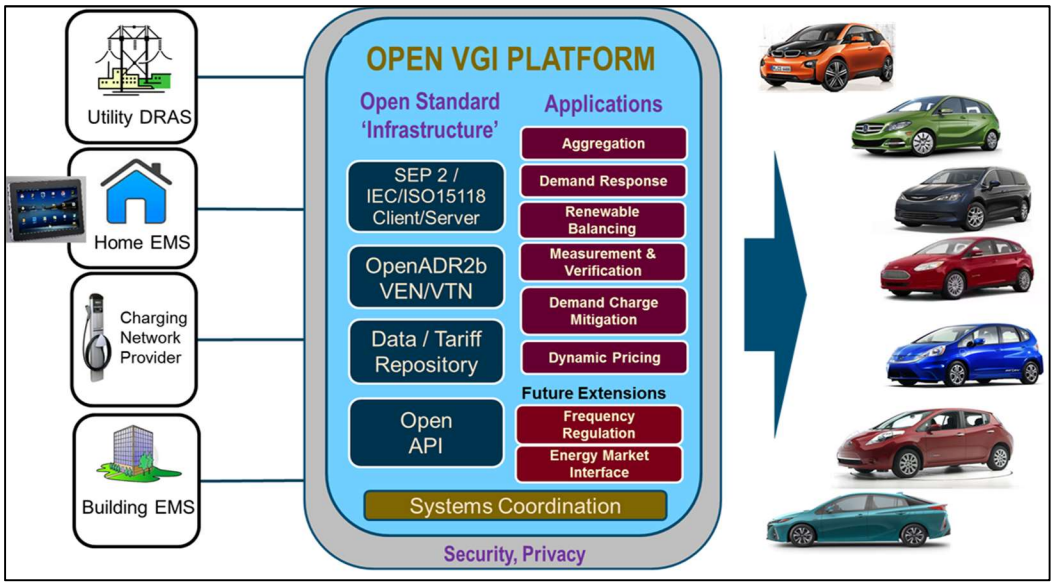
After a full year of occupancy performance data, this project is expected to be complete and a final report is expected in Q1 2020.

DR16.02 Open Vehicle Grid Integration Platform (OVGIP)

Overview

Plug-in Electric Vehicles (PEVs) and Electric Vehicles (EVs) represent a rapidly-growing class of smart, connected loads with increasing nationwide adoption. Utilities have an opportunity to manage PEV charging in a manner consistent with DR and DSM objectives. However, the PEV infrastructure and load management landscape is currently fragmented, with PEVs and charging network providers positioning themselves as aggregators seeking to leverage their proprietary telematics, charging networks, and interfaces.

This EPRI collaborative project was designed to provide aggregated demand response management of customer's PEV charging load in the residential environment. SCE used the OpenADR 2.0b protocol to communicate DR Event signals/requests to stop PEV charging via the OVGIP (aggregator). The purpose of the project was to assess how the OVGIP can best determine, report and facilitate OEM(s) to provide grid services through demand side management and to evaluate the DR measurement data results (10/10 baseline method) collected through the OVGIP to determine the use of OEM measurement capabilities for future programs (non-billing purposes).



EPRI OVGIP Project Architecture

The overall EPRI objective is to advance the open platform concept into the product development and testing stages. It will assess the effectiveness of an open standards-based platform to seamlessly integrate PEV charging with grid objectives through DR and DSM mechanisms for its member utilities and other parties.

The project includes the following research objectives:

1. Creating requirements and use cases for a unified grid services platform that is secure, low-cost, open, and extensible.
2. Developing an architecture and functional representation of a platform that enables PEV integration into DR and DSM use cases.
3. Assessing platform performance against industry requirements through field trials at utility host sites.
4. Assess how this platform will enable multiple manufacturers to participate in DR programs regardless of the communication protocol used by these manufacturers to communicate with EVs.
5. Demonstrate how the OVGIP can enable the utilities to use one platform to reach out to multiple Original Equipment Manufacturers (OEMs) and receive an aggregated capacity from these OEMs.

Project deliverables are:

- A report describing the technical requirements, architecture, design, and open-interface specifications for EVSE DR communications
- Open grid services platform software to integrate and apply to future extensions of other end-use devices and additional grid services
- An EPRI final report (collaborators only), with public version posted on the ETCC website when it becomes available

Collaboration

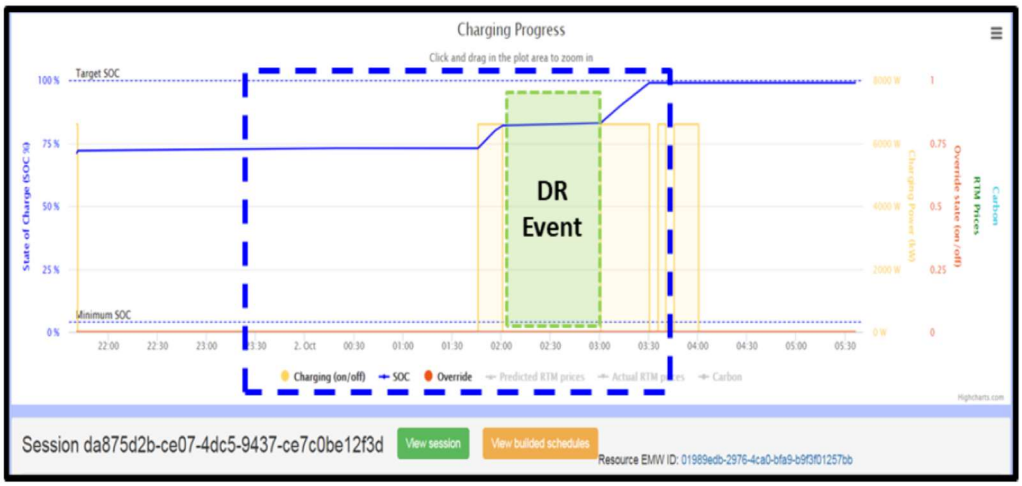
OEMs are enhancing their platforms to enable accurate DR action when dispatch events are received. The project is in collaboration with EPRI, Sumitomo Electric Innovation (SEI), multiple industry vehicle OEMs, and utilities. EPRI is coordinating the participating utilities and will prepare the final report. Automotive industry participants include: BMW, Daimler, Fiat Chrysler, Ford, Honda, Nissan, and Toyota (Observers are: GM, Tesla and VW Group).

The following utilities form the development team: PG&E, SDG&E, SMUD, Puget Sound Energy, Hawaiian Electric, New York Power Authority, Southern Company, Duke Energy, American Electric Power, and Con Edison.

Results/Status

The project entailed the development and demonstration of the OVGIP to provide the communications interface between SCE and Honda FIT EV customers to respond to day ahead DR signals. The communications architecture consisted of SCE generated OpenADR signals for EV load curtailment to the OVGIP to the Honda vehicle telematics system. The measurement and verification process was predicated on an applied 10/10 baseline (average of previous 10-day specific watt hour meter data) methodology utilizing EV customer's whole house meter data extrapolated from the SCE Green Button system.

The SCE portion of the joint EPRI project was a five-month (May through October 2018) test and demonstration pilot to assess the functionality and effectiveness of the OVGIP central server interface between the utility and the PEV, and the EV customer. Final results will include an analysis of the resulting data to formulate an estimate of the larger scale impact from using EVs as a DR resource.



EV Charging Profile with DR Event

The final EPRI report, including a DR communications assessment and summary of EV user interviews, is targeted for completion by the first quarter of 2019

Next Steps

The research priority of the OVGIP Residential DR Project was to verify the capability of the OVGIP prototype to provide a viable interface and communications connection between the utility and the customer PEVs for managing EV charging loads. The project validated the viability for DR aggregation of PEV charging load utilizing the OEM telematics vehicle connection and the ability to collect and report individual customer charging profile data for purposes of verification.

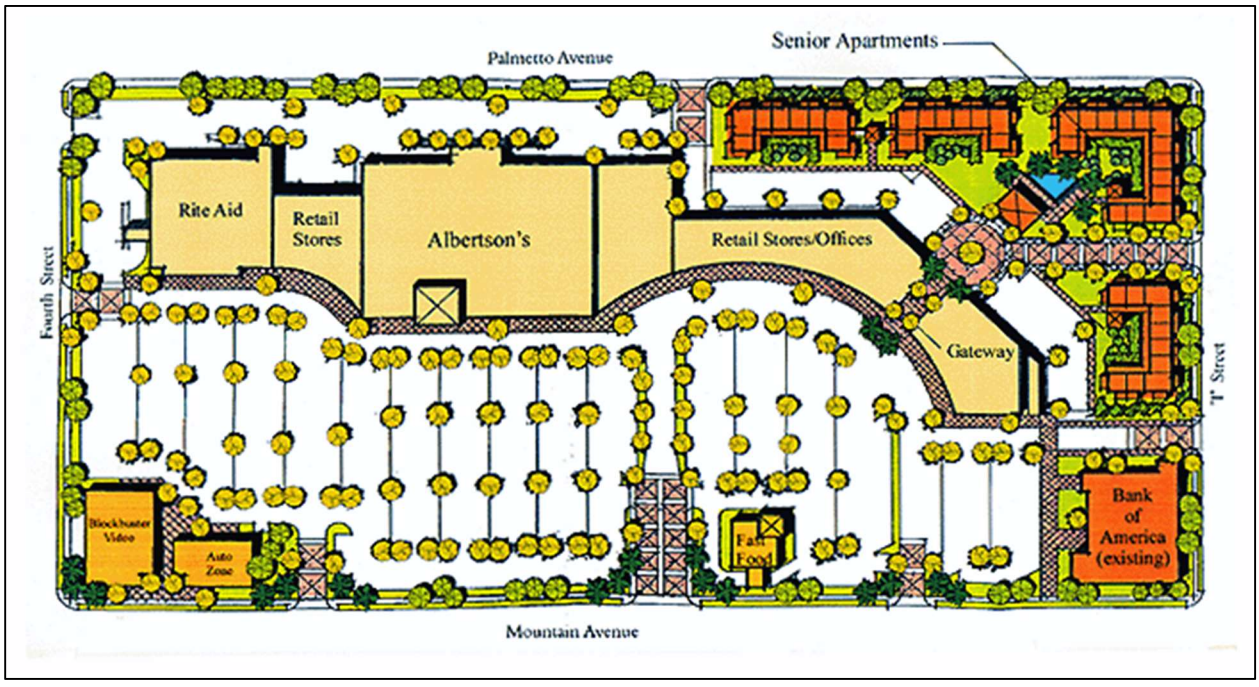
EPRI will continue to assess the utilization of PEVs to provide both excess supply side (add charging load) and supply side (reduce charging load) capacity that is responsive to signals in day ahead and near real time scenarios - the ability to exercise PEVs as a controllable dispatchable load for utilization as a load modifier resource.

DR17.02 Customer-Centric Approach to Scaling IDSM Retrofits

Overview

California's Building Energy Efficiency Standards are moving the state closer to achieving its ZNE goals of: all new low-rise residential buildings are to be ZNE by 2020; and all new commercial buildings are to be ZNE by 2030. Achieving these goals will require a major improvement in energy efficiency in the construction industry's building practices and presents occupants with energy, cost, and GHG reduction opportunities. While the state's ZNE goals are a major step forward, they represent a fraction of the energy, cost, and GHG reductions that buildings can achieve.

This project is a partnership through a CEC EPIC solicitation, with EPRI as the awardee. The EPIC solicitation is titled Scaling Customer-Centric Energy Efficiency Retrofits with Integrated Demand Side Management (IDSM). The project's primary goal is to formulate, demonstrate, and evaluate an innovative retrofit methodology combining a traditional technical approach with customer-centric needs. The focus is on designing IDSM/ZNE packages and guidelines for EE retrofits that could enable scaling some DR measures in existing low-income communities.



Site Plan of Senior Apartments and Mixed Use Center

This project is intended to demonstrate IDSM and ZNE solutions in the MF sector category for a retrofit application. A LIMF property was used in the demonstration.

The DR research project objectives are:

- Formulate DR solutions for MF residences.
- Create new resources for ZNE retrofit solutions to support DR.
- Create retrofit guidelines for including DR in low-income communities.
- Develop a list of enabling DR technologies that create customer-centric packages for future retrofits.

Collaboration

Many stakeholders are involved in this project starting with the CEC who developed the EPIC solicitation. EPRI won the EPIC solicitation and is therefore the overall project lead. Another key stakeholder is LINC Housing; affordable housing owner and operator. SCE is the host utility, technology lead, grid-side lead, and is providing SME assistance through Kliewer and Associates. Sustainable consulting is provided by BIRAenergy.

Results/Status

Construction work is complete on the Energy Efficient Retrofit Packages (EERP). As part of the EERP, the apartment units underwent HVAC retrofits at a pace of ten units per week. The data collection devices are installed and commissioned, utilizing circuit-level plug load data collection devices. The tankless gas water heaters were installed in lieu of heat pump water heaters (HPWH) as physical room for installation of HPWH was not available.

Next Steps

Construction was completed in Q4 2018 and data collection on the performance of the DR measures is ongoing. Project updates are being provided to all stakeholders and the learnings from this project are shared in real time at building industry meetings and forums. The final report draft is scheduled for delivery in January of 2020; after final approval the report will be posted on the ETCC website and the learnings shared through ETCC meetings and other engagement platforms.

DR17.03 Demonstration of Affordable, Comfortable, and Grid-Integrated ZNE Communities

Overview

A primary goal of this project is to demonstrate the technical and economic feasibility of advanced measures for ZNE new construction homes within the MF housing sector, in accordance with the research objectives of the CEC grant funding opportunity. A secondary objective is to study how ZNE MF homes perform with solar and storage. The project will examine the appropriate strategies for effective integration of ZNE homes to the electric grid via load management and load modifying end use operation, and by using appropriate DR emerging technologies such as controls for smart air conditioning and other electric end use measures.

Architectural Rendering of ZNE MF Housing

As with all ZNE construction, there are important DR elements in the building design and operation that can accommodate the solar and energy storage systems that are often included as part of the overall integration. By examining how the systems can interact and optimize their operation for meeting the intent of the ZNE design, as well as provide a better understanding of maintaining a minimal impact on the local grid system, the project in collaboration with EPRI as the project lead will provide valuable information for the MF building industry, one of the most robust new construction sectors in California.

Project outcomes are also expected to provide input to the development of the California Energy Code for future program cycles; help develop neighborhood planning tools for all-electric master communities; assist in cost-effective ZNE implementation for developers and builders; and support utility distribution system planning to consider ZNE home electrical load performance in future upgrades to the distribution planning models for the inclusion of DERs.

The general contractor for this site will install measure packages consisting of the following innovative ZNE housing measures:

1. Induction cooktops
2. Open ADR-connected API-controllable heat pump water heaters
3. Heat pump dryers
4. Electric barbeque grills
5. High-performance windows
6. Variable refrigerant flow heat pumps
7. Network-connected smart thermostats with DR capabilities
8. Ducts located in conditioned attic spaces
9. Voice assistant-driven smart home energy management systems
10. Smart intermittent ventilation systems
11. Integrated smart electric load panels, with built-in circuit energy monitoring
12. Integrated grid distribution planning for ZNE
13. Integrated DR controls to improve electric load shaping

This project research objectives are to assess the efficacy of the ZNE measures for DR flexibility, as well as provide customer feedback on the implementation of voice-activated DR control in-home technologies and to assess the storage and shifting performance of grid-interactive heat pump water heaters.

Collaboration

This project includes collaboration with EPRI as the overall project lead (under contract to the California Energy Commission), and with Meritage Homes as the builder and seller of the MF units. SCE is providing technical assistance with the construction management and ZNE innovation design recommendations.

Results/Status

Construction of the housing units is underway with the first units expected to be completed by the end of April 2019. The measure packages listed above will be evaluated using a whole-building approach, and the builder incorporated many emerging technologies (ETs) into the design.

Next Steps

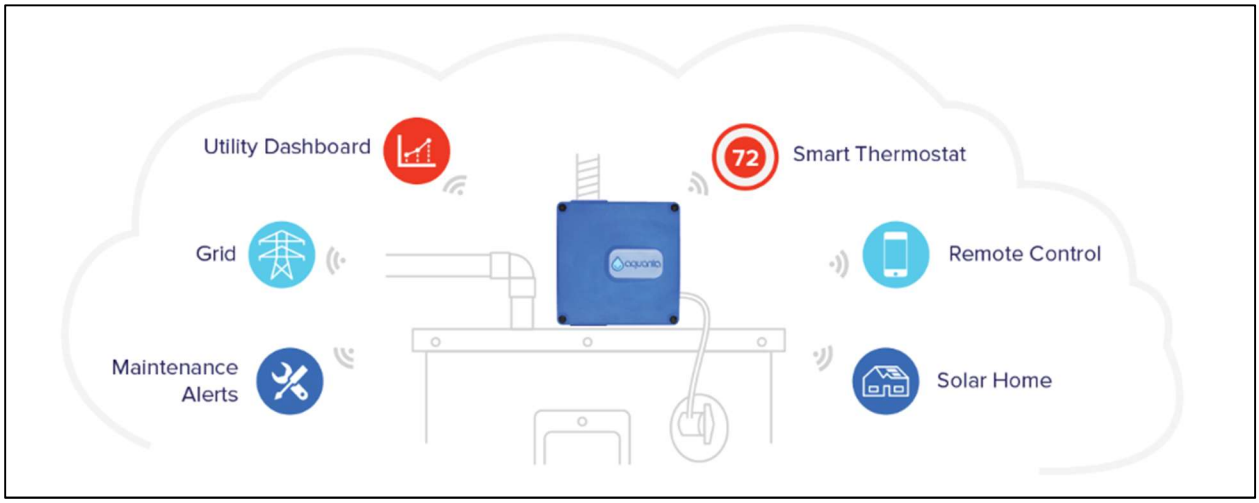
Testing and data monitoring will begin upon resident occupation and will continue until December 31, 2019. The final DR measure report is expected by June 30, 2020. After review and approval, the report will be posted to the ETCC website and the learnings shared through ETCC meetings and other engagement platforms.

DR17.06 Aquanta Smart Water Heater Controller

Overview

SCE and other stakeholders in California are interested in examining the number of advanced load management and dispatchable DR opportunities for future GHG-mitigating technologies, such as non-gas water heater systems. In efforts to advance overall research and learn more about advanced Electric Water Heater (EWH) control systems, SCE will perform an initial evaluation and assessment on Aquanta, a water heater controller.

SCE started a process to conduct laboratory testing in Phase 1 and field testing in a potential Phase 2. This testing will help understand the controller's communication technology, how the device may give customers better energy management, and how utilities may use it for strategic flexible DR initiatives with improved GHG benefits.



Smart Water Heater Controller Features

Aquanta is a "smart" controller for storage water heaters. Utility use cases include fast-payback EE- and GHG-reduction programs, DR, Time-of-Use (TOU) pricing enablement, and excess renewable generation alleviation. End-use applications include electric and gas water heater controls in residential and small commercial applications (for 120-gallon or less storage water heaters). This SCE project will assess the device's DR control strategies for local "learning" control algorithms, as well as advanced capabilities for DR flexibility using open source communications.

Collaboration

This project was initiated by the Emerging Technologies Coordinating Council (ETCC) with stakeholders from PG&E, SCE, SoCalGas, SDG&E, the CEC, SMUD, and L.A. DWP. SCE's ET division was selected to investigate OpenADR compliance with Aquanta's cloud-based system. The SCE Technology Test Center (TTC) developed a test bed to evaluate Aquanta's control with other water heaters.

Results/Status

The project is testing the Aquanta system and identifying the performance architecture to achieve both hot water use efficiency and energy optimization. This effort includes system installation activities and testing that began in early 2018.

The scope of work includes these test plan scenarios:

1. Baseline testing and controller conditioning: Run for two weeks under a normal water draw profile, with no controller operational influence.
2. Load curtailment testing: Run a 24-hour test, and schedule a two-hour load curtailment event at 6:00 p.m.
3. TOU pricing controls: Run two 24-hour tests for TOU-DA-weekdays and weekends.
4. Grid Integrated Water Heater (GIWH) thermal storage: Run 24-hour tests under a thermal storage profile test for flexible DR opportunities.

Next Steps

The work to date demonstrates that effective controls are available for electric water heaters, to reduce demand and energy consumption. These controls learn and adapt to the unique usage patterns of a water heater, to reduce standing losses, and ensure water heating is only operational when needed, ideally at low electricity cost periods. These controls are applicable to electric and gas tank/storage water.

SCE's TTC is near completion of their investigation of the Aquanta controller to confirm the product is an adoptable retrofit solution and will share the results with the ETCC stakeholders in early 2019 as the final report is assembled and completed.

DR17.14 Packaged Ultra Low Charge NH3 Refrigeration Field Monitoring

Overview

According to the International Institute of Ammonia Refrigeration (IIAR), ammonia is 3 to 20% more thermodynamically efficient than competitive synthetic refrigerants. This allows ammonia-based refrigeration systems to use less power to maintain a specific refrigeration load as well as load reduction. This assessment will demonstrate the replacement of hydrofluorocarbons (HFC) refrigerants with zero GWP ammonia and how these new emerging systems can provide improved operations and demand flexibility to California cold storage users in various refrigeration applications, with an emphasis on "load shifting" strategies.

The project research team will determine the site equipment control strategies to be demonstrated at two facilities; one a 240,000 square foot Long Beach plant and a smaller 70,000 square foot facility at a South Gate, CA plant. The goal is to achieve at least 20% demand reduction by taking advantage of the manufacturer's design features and inherent (built-in) site storage capabilities of the building.

Refrigeration Facility Field Test Site

This assessment will also demonstrate how replacing hydrofluorocarbons (HFC) refrigerants with zero GWP ammonia can provide an integrated solution of both efficient EE savings reductions and flexible DR benefits to California cold storage users in various refrigeration applications. This field demonstration is examining both demand side management opportunities along with mitigating GWP sources.

The load shifting strategy for DR opportunities is based on the thermal mass of frozen or refrigerated food, which will allow customers to temporarily shed electrical load and meet permanent peak shift requirements. Ongoing performance monitoring of all energy and demand metrics will enable real-time data acquisition and analytics, metering, and DR controls. These activities will verify usage and flexible DR abilities (to add load, reduce load, and shift load) and will help build a calculation tool to support the technology's market adoption and knowledge transfer. This information will then be extrapolated to other facilities within SCE service territory and California.

Collaboration

Project stakeholders include NXTCOLD/Hillphoenix, General Cold Storage, Lineage Logistics, Cypress Ltd., and the SCE Emerging Products team.

Stakeholder levels of engagement are:

- NXTCOLD/Hillphoenix; equipment manufacturer
- General Cold Storage; Lineage Logistics, field test sites, customers
- SCE Emerging Products; Project Lead/Designer
- Cypress Ltd.; M&V, Project Consultant

Results/Status

The packaged system optimization and performance analysis has been completed. Instrumentation for monitoring DR process performance has been installed at the Port of Long Beach site. Based on the South Gate new construction site cold storage and blast freeze operational requirements, this project is set to demonstrate flexible DR control options and strategies, including testing and measuring results. These results were intended to inform the team of opportunities for the development of cost-effective measures for the SCE AutoDR incentive program.

Opportunities to optimize performance of these new systems were identified as part of the efforts during the first half of 2018. The decision was made to take this opportunity to demonstrate how to further optimize this equipment. Scope was added to the project to modify systems at both sites, confirm the improvements, and then proceed with DR efforts during the first half of 2019.

Next Steps

The final project report will include the results of energy, demand, temperature, performance improvements/benefits and power metering resulting from DR testing strategies, with a draft available third quarter 2019.

4. Projects Initiated Q3 – Q4 2018

DR18.06 Willowbrook Low-Income Multi-Family DER: Energy Storage with PV

Overview

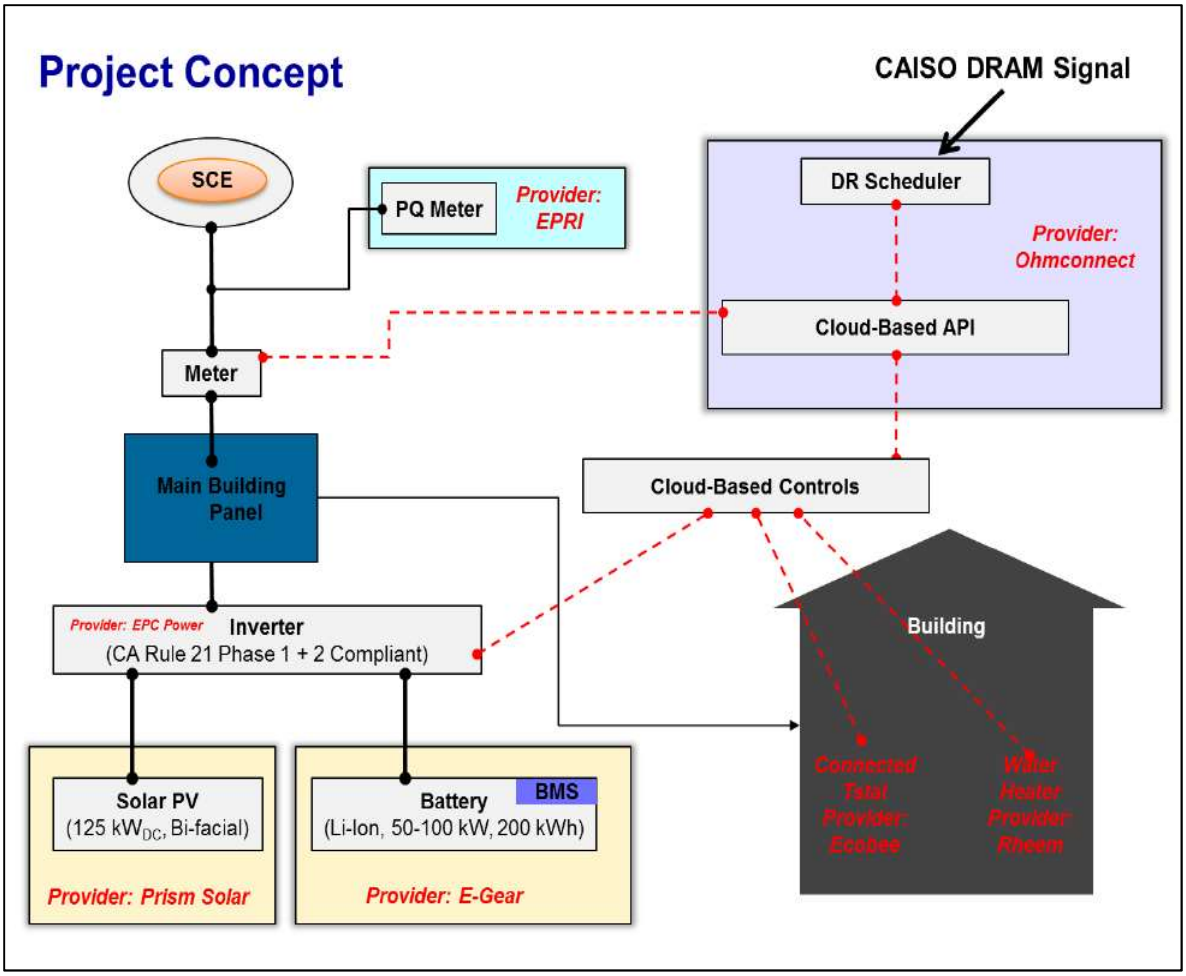
This project will examine the performance and customer engagement of advanced DR enabling technologies in a new low-income residential community being developed by LINC Housing in the Willowbrook neighborhood (Compton, CA) called Mosaic Gardens at Willowbrook. The LINC project constitutes 61 apartment homes of 1-, 2- and 3-bedrooms, of which half are family housing and another half reserved for formerly homeless and regular users of the county services. The community also has a common area with a fitness center, a community kitchen, a computer lab, and a children's play area.

This project showcases a host of emerging technology advances that individually and together can contribute substantially to a better understanding of DER integration, an important component of SCE's DR research goals. Of specific relevance, this project will address:

1. A DER integration platform that is communications-agnostic for coordinated DER operation at the community scale to better enable management of high DER penetration in constrained distribution circuits
2. Multi-port storage - smart inverter configuration that enables a "shared savings" model between customers and utilities for possible DR program benefits "stacking"
3. Coordinated ISO and utility load shaping and demand management needs through the integration of solar, storage and demand response including behavioral demand response options
4. Development and implementation of innovative scenario-testing techniques to evaluate new configurations for solar and grid optimization to support resiliency at the local grid level with customer assets

Collaboration

The project is being designed and operated by EPRI under a contract with the California Energy Commission's EPIC program. SCE is co-funding the project through an EPRI supplemental program agreement. Other partners include LINC Housing, Prism Solar, E-Gear, EPC Power, and Ohmconnect.



Results/Status

As of the end of 2018, the CEC has granted the project team a 2-3 month time extension beyond the current date due to battery delivery delays. The contracts have been signed with the contractors, LINC housing, etc. Although no construction has begun yet, drawings were scheduled to be submitted for plan check review in December. Construction is planned to start in early 2019 after all subcontracts have been initiated and final design is completed.

Next Steps

The final project report is not expected until 2020, and will include the results of energy, demand, temperature, and power metering resulting from DR testing strategies that are still under review, pending the availability of enabling technologies and customer occupancy schedules.

5. Budget

The following is a breakdown of the total program expenditures to date from SCE's 2018-2022 EM&T authorized budget. These values are based on the EM&T expenditures as reported in SCE's Monthly Report on Interruptible Load Programs and Demand Response Programs, Table I2, SCE Demand Response Programs and Activities Expenditures and Funding, 2018.

Values do not reflect commitments for projects, including those described in this report, which have been scoped and contracted, but not yet executed.

Southern California Edison's Emerging Markets and Technology Program (D.17-12-003)	
Approved 2018-2022 Budget	$14,610,000
Expenditures to date (Q4 2018)	$2,301,711
2018-2022 Budget Remaining	$12,308,289