Demand Response Emerging Markets and Technology Program

Semi-Annual Report: Q3 – Q4 2019

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

March 2020

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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
API	Application Program Interface
ASHRAE	American Society of Heating and Air Conditioning Engineers
AT	Advanced Technology
AutoDR	Automated Demand Response
BAN	Building Area Network
BBI	Better Buildings Initiative
BCD	Business Customer Division
BE	Building Electrification
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 Automation 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 & Technology
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
LADWP	Los Angeles Department of Water and Power
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
NDA	Non-Disclosure Agreement
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
PG&E	Pacific Gas and Electric
PLMA	Peak Load Management Alliance
PLS	Permanent Load Shift

PMS	Property Management System
PRP	Preferred Resource Pilot
PSPS	Public Safety Power Shutoffs
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
SDG&E	San Diego Gas and Electric
SEER	Seasonal Energy Efficiency Ratio
SEPA	Smart Electric Power Alliance
SGIP	Self-Generation Incentive Program
SME	Subject Matter Expert
SMUD	Sacramento Municipal Utility District
SoCalGas	Southern California Gas Company
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
VEN	Virtual End Node
VNEM	Virtual Net Energy Metering
VRF	Variable Refrigerant Flow
WW	Waste Water
WWTP	Wastewater Treatment Plant
ZNE	Zero Net Energy

1. Summary

Southern California Edison (SCE) submits this 2019 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 Technology (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 wholesale market resources. The program funds research demonstrations, studies, the assessment of advanced DR communications protocols, and conducts field trials and laboratory tests that help enable the innovative high tech and consumer markets to adopt DR methods and standards that advocate for continuous improvement in DR technological innovation.

SCE works collaboratively with other California Investor-Owned Utilities (IOUs), as well as with other DR research organizations, national laboratories, trade allies, and state agencies, to investigate innovative applications and software that could enable increased customer and stakeholder benefits in DR markets and tariffs. Reports from current and previous EM&T studies can be found at the Emerging Technology Coordinating Council (ETCC) website at www.etcc-ca.com.

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, 2019 and December 31, 2019, for Q3 and Q4 of program year 2019.

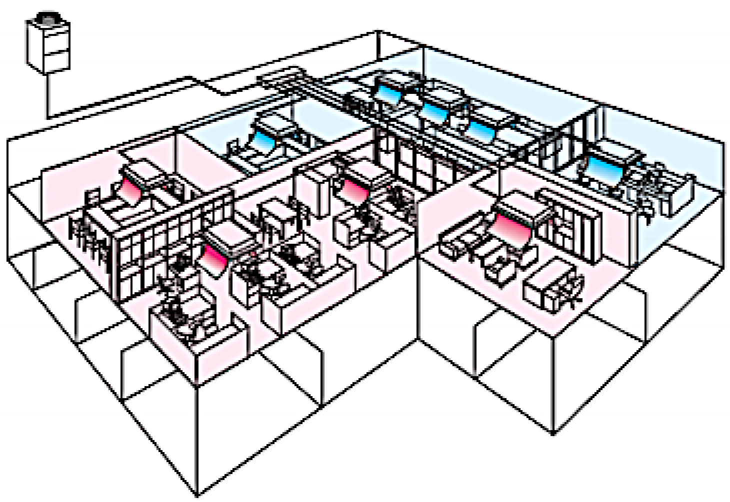
2. Projects Completed Q3 – Q4 2019

DR18.11 AutoDR Capabilities of Variable Refrigerant Flow Technologies: Manufacturer Outreach

Overview

This project was a one year "upstream" manufacturer outreach initiative to assess strategies to increase the adoption of OpenADR in the HVAC industry, building on SCE efforts to increase outreach to manufacturers of Variable Refrigerant Flow (VRF) equipment. VRF systems with their advanced controls are a potential end use technology for new models of DR programs such as "shift" and "shimmy". These VRF systems are characterized by variable speed inverters, zone-based design and integrated factory controls that could be enabled with OpenADR communications technology at the factory or later in the HVAC distribution channel.

Typical VRF System Installation



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The VRF outreach project assessed the extent to which manufacturers could enhance VRF equipment with OpenADR capabilities, and whether the systems were compliant with the California Title 24 energy code in effect at that time. SCE had learned in previous studies that VRF systems often have controls to manually carry out demand reduction for energy efficiency, but these were not sufficiently integrated to perform OpenADR functions. The project schedule was a reasonable approach to the previous longer-term initiative to minimize impact on participants.

At that time, manufacturers were hesitant to invest in such capabilities until they received clear market signals that SCE and small business customers would purchase such DR-ready products. This study wanted to reassess their interests.

The survey phase of this work was conducted to assess the understanding among major VRF manufacturers about SCE's OpenADR product requirements and Title 24 rules for demand responsive controls. The outreach and training performed was intended to educate manufacturers on the value of developing plug-and-play products that exceed minimum T-24 requirements. The target markets for this OpenADR enabled equipment initiative are the Small to Medium Business (SMB) customers who otherwise lack the technical and financial resources to perform the custom programming necessary to retrofit their systems for OpenADR.

Collaboration

This project was led by the SCE EM&T program, with support from other SCE groups that included OpenADR technology group, DRAS management and SCE DR program staff. The CEC provided policy support and Energy Solutions performed much of the outreach and organized the workshop. PG&E and Quality Logic were also on hand to provide their expertise and educational services.

Results/Status

A consistent theme throughout the VRF project was that manufacturers needed more guidance from utilities on OpenADR capabilities and market need. This includes information on when OpenADR signals would be set, how frequently, which customers would receive these signals, and details about OpenADR certification. VRF manufacturers recommended that utilities form as a group to develop a common method of DR event signaling. A standardized approach would be used by all manufacturers to develop common control strategies that met the load shed objectives of utility DR programs. SCE is taking these recommendations into consideration in its review and planning for future OpenADR activities.

Next Steps

The activities of this project and its findings will be disseminated and reviewed by DR stakeholders (program designers and policy makers) in the Final Report titled "AutoDR Capabilities of Variable Refrigerant Flow Technologies: Manufacturer Outreach" which can be located at: https://www.etcc-ca.com/reports/

DR17.17 DER Integration with Water District

Overview

SCE partnered with the Irvine Ranch Water District (IRWD) to identify specific measures and strategies on how to enhance opportunities in the water sector for preferred resources and pursue the development of cost-effective water-energy demand response solutions. The purpose of this current project was to specifically investigate IRWD's flexible load opportunities associated with water pumping over several operational seasons (18 months) to best assess system flexibility.

IRWD was interested in facilitating changes in their operations to meet overgeneration needs, examining their existing hydraulic modeling tools to simulate shifting pumping operations to occur during periods of overgeneration which was assumed for modeling purposes to be 9:00 am to 4:00 pm. Managing, staging, pumping and storing of water is a form of energy storage that may be a resource for SCE as a form of "shift" and a potential cost benefit to water districts.

Two operational alternatives were developed and simulated within the hydraulic model. Alternative 1 maximized pumping between 9:00 am to 4:00 pm. Alternative 2 built on the daily adjustments of Alternative 1, and also maximized pumping from mid-February to mid-June (when overgeneration is expected to increase in the future) by adding seasonal recycled water storage. Model results were used to quantify the impact of changing the pumping schedules in terms of annual energy use. The difference between the current energy use and the energy use of the two alternatives defined the potential for overgeneration mitigation support.

This project also investigated how IRWD could "shift" electrical consumption for pumping during periods of power overproduction from renewable generation, and simultaneously reducing power use when prices are the highest and the grid is near capacity. This project developed a proof of concept for use of a water distribution system hydraulic model to estimate how the timing of resources and availability for SCE and the water district could be adjusted to alternative rate scenarios.

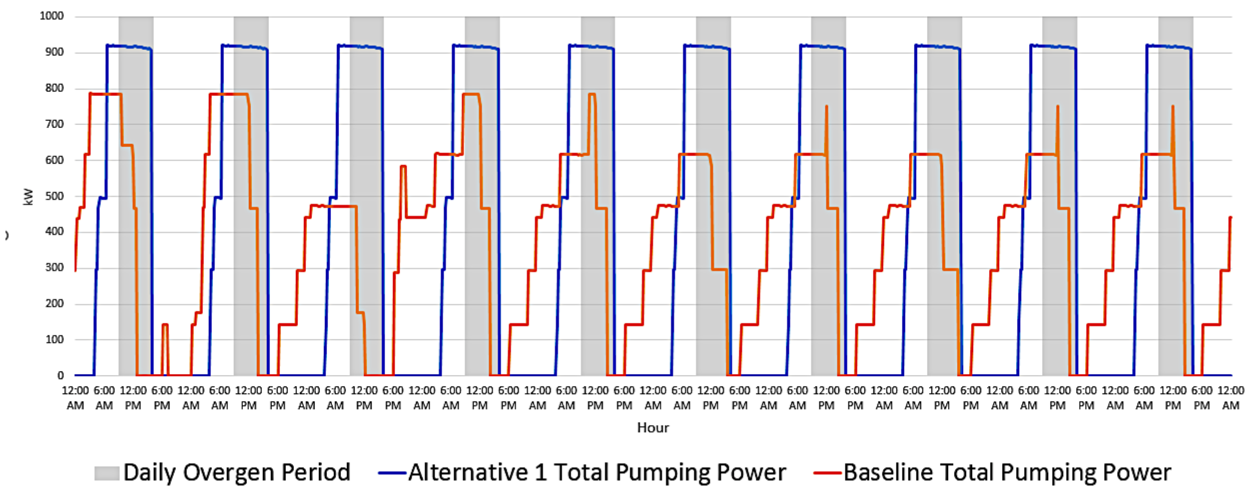
Collaboration

The project is a collaboration between SCE, the IRWD, Water Energy Innovations, other water agencies and subject matter experts, and West Yost Associates. The team worked together to develop a mutual electric service and water operations needs assessment between SCE and the IRWD that could include DR opportunities.

Results/Status

The results indicate that there is strong potential to “shift” water operations, both on a daily and seasonal basis, in the Lake Forest service area of the IRWD recycled water system, based primarily on operational changes. The Alternative 1 impacts could be accomplished with daily changes to operations and minimal infrastructure investment. The Alternative 2 impacts would require substantial changes to operations on a seasonal basis, as well as significant investment in new storage.

Daily Power Pumping Requirements: Baseline and Alternative 1



As development of operational “shift” alternatives progressed, it also became clear that significant effort would be required to understand, define, and quantify external constraints applied on each alternative flow balance. If IRWD was to change operations to accommodate new rate designs, it would be prudent for them to fully understand the boundary conditions before estimating a level of effort for evaluation and modeling or making conceptual conclusions about potential impact to energy use and subsequent energy costs for their “shift” strategies.

Next Steps

The study found that IRWD, given appropriate rate designs in the future, could invest in long term additional infrastructure improvements and additional pumping capacity with storage to more closely align energy usage to overgeneration periods. IRWD system planners however, in the absence of those retail rate or “shift” program designs, are hesitant to make the capital investments at this time. The final report can be found at: http://www.waterenergyinnovations.com/

DR17.14 Packaged Ultra Low Charge NH3 Refrigeration Field Monitoring

Overview

The original scope of DR17.14 was to demonstrate and assess improved energy efficiency with continuous performance monitoring, flexible demand response and certified ADR capabilities for both low and medium temp refrigeration. The project focused on new “packaged” refrigeration systems utilizing an ultra-low charge, zero GWP, flexible tonnage packaged units. Continuous monitoring and advanced control strategies should have enabled Flexible DR capabilities. These systems are more energy efficient than incumbent ammonia-based technologies. The project included ongoing comprehensive real-time monitoring of all metrics to build a calibrated calculation tool to support further market adoption and/or program.

It was expected to achieve least 20% demand reduction by taking advantage of built-in inherent storage capabilities based on the thermal mass of frozen and refrigerated food—that would allow the end user to temporarily shed, shift or adjust power demand, key enablers for fast and flexible demand response. Additionally, electric defrost control was expected to add load to ameliorate renewable grid effects.

In summary, this project was originally designed to optimize controls and component operations, then validate DR function, including reducing and increasing demand upon receipt of the appropriate signal to the packaged refrigeration equipment.

Results/Status

Due to technical difficulties, the DR elements of Ultra Low Charge NH3 Packaged Refrigeration Technology Field Optimization (IMT-2016-0322) were excluded from the project during the second half of 2019. As such, SCE has no results from DR17.14 in this report. The energy efficiency portion of the project, ET18SCE1151, has been completed and a final report will be prepared by end of Q2 2020.

DR 15.21 Mosaic Gardens New Construction, Low-Income Multi-Family ZNE

Overview

Mosaic Gardens, located in Pomona, California, is a new residential complex that has demonstrated how innovative Zero Net Energy (ZNE) measures and emerging DR technology can be effectively adopted in new construction. The low-income multi-family residential development consists of forty-six apartment units that vary in size from one to three bedrooms. This facility serves tenants that are low-income, with half the units designated for displaced residents.

Mosaic Gardens

An opportunity for DR research presented itself to demonstrate a new type of HVAC control platform for the building. A mesh network system utilizing wireless state-of-the-art smart communicating thermostats was installed in each apartment. A wireless gateway was provided in the main facility area to route the communications signals that provide both comfort and additional control and monitoring of the individual all-electric heat pumps. The communication between the gateway and each of the thermostats is part of a secure “peer to peer” wireless mesh network. Tenants do not need to have their own internet because the thermostat portal is served by a common internet connection in the building. Individual dashboards for building tenants have advanced features and allow customization to reduce energy use.

Wireless Smart Thermostat Control System

During the initial design phase, the building owner was focused on achieving Leadership in Energy and Environmental Design (LEED) with Platinum level certified construction. The owner requested that SCE help undertake and incentivize additional building design modifications and measures to reach ZNE status. The project was designed to assess the energy savings due to the LEED design over an 18-month operational period after the building was occupied.

Collaboration

SCE's stakeholders include EM&T, the Savings by Design group, the SCE Codes and Standards group, and the developer LINC Housing to enhance DR operations for the apartment residents.

Results/Status

The advanced mesh network system provides multiple benefits in being able to remotely monitor a large number of heat pump systems, delivers automated alarms warning of spaces out of temperature range, and assists management and technicians to respond quickly to any maintenance issues. The DR results were modeled to be typical of other residential programs, with an expected range of 0.2 to 0.5 kW per hour of event, due to the high efficiency of the heat pump HVAC systems and the ZNE building design. Learnings will be shared with stakeholders and others.

Next Steps

The outcomes of this project with recommendations for future program designs will be shared with DR stakeholders and with the CEC staff. The final SCE report for the

DR aspects of this overall ZNE demonstration project with the mesh network design can be found at: https://www.dret-ca.com

3. Projects Continued Q3 – Q4 2019

DR19.03 Smart Speakers

Overview

The EM&T program reviews both innovative technologies and traditional consumer appliances for DR emerging opportunities. The primary goal of this project was to understand how connected thermostats and other common household end uses can optimize their energy usage via "smart speaker" voice commands subject to TOU rates and customer preferences. Voice interactions related to energy – usage, estimated bill, best times to use appliances – are being evaluated to identify optimal voice command "skills" and "smart speaker" interactions. This work leverages the previous "smart speaker" work funded by the CEC and supported by SCE under the EPIC GFO 15-311 RATES transactive energy project.

The secondary objective of this project is to develop optimization algorithms and voice interaction *vocabulary* specific for time-of-use rate response. The project will use a meter-based assessment that is individualized for each home. The goal will be to understand energy usage impacts and to potentially develop a deemed IDSM measure for both residential energy efficiency and demand response programs.

In Home Smart Speaker and Control Equipment

Customers in the study can ask energy related questions and set their home energy optimization preferences using a smart speaker. A "smart hub" provides algorithms to use various information - the customer TOU rate, energy use and preferences – to optimize connected devices. Device settings are adjusted to run less during peak times. This project will demonstrate the smart speaker's interactive capabilities with household occupants and will assess whether the smart speaker can enable customers to manage their energy use and cost by optimizing connected devices.

Collaboration

This project leverages a previous EPIC grant project funded by the CEC and supported by SCE. This was a transactive energy pilot that developed certain software and smart speaker skills that are foundational to this current project. This new work is a collaboration among three groups within SCE – EM&T, SCE Product Development, other technology stakeholders, and the CEC grant awardees.

Results/Status

This project was initiated in mid-2019 with an interest to develop software to respond to SCE's TOU rate signals via in home technology. Subsequently, a monitoring and evaluation plan was developed, and initial quotes for hardware installation at the field sites were solicited. The monitoring and evaluation (M&E) plan was finalized in late 2019 to streamline the project objectives.

In 2019, the software, communications gateway modules were delivered, and a contract for installation of the smart speakers, thermostats, smart plugs, and lamps was finalized. Recruitment materials were completed and submitted for legal review. Customer recruitment began in Q4 2019 to avoid the Labor Day holiday. This initial campaign elicited 115 applications the first month. In October additional emails were sent out to recruit additional participants. Ultimately 140 applications for participation were approved.

All equipment was received and software modifications to the smart speaker system were subject to final testing prior to installation. The first installations were completed in November, and a second wave in December. The updated Amazon Alexa skill was submitted for certification by Amazon and approved before year end.

Next Steps

The study is still in progress and on schedule. All installations will be complete by the end of February 2020. The draft survey will be finalized and sent to participants and customer monitoring of both behavior change, energy savings, and response to TOU events will commence. Data will be collected through 2020.

DR19.02 Low-Income Multi-Family Battery Storage, Solar PV and Data Collection

Overview

Battery Energy Storage Systems (BESS) and solar PV systems are being integrated into Multi-Family owner portfolios at a growing number of sites across California. This project is designed to assess how the BESS can provide demand response benefits, along with the potential impact on local distribution transformers, the distribution infrastructure, and customer electric bills. These interactive effects need to be better understood so SCE can provide better customer support for future Distributed Energy Resource (DER) installations, improve the models for grid infrastructure design and planning, and gain experiential data from these customer assets for new models of DR.

Battery Energy Storage System in Multifamily Building

The project will give SCE a better understanding of how the various BESS, PV, smart inverters, and related components work as a system in the context of Low-Income or other Multi-Family housing, and how they can act as a DER as well as to provide grid-responsive services, “shift” for dynamic pricing response, or backup energy.

To enable the DR operation of the battery storage system, the project will leverage previous BESS research to gain a comprehensive understanding of the system's techno-economic performance and its benefits/impacts for the customer and grid operator as a possible new DER resource. The planned study will provide in-field case studies for SCE and its technical stakeholders for the continued adoption of customer energy storage as it impacts tariff compliance, customer and grid economics, and technical grid services that might be achieved through independent and coordinated operation of these potentially flexible assets.

Collaboration

This work is a collaboration between two SCE groups – Emerging Markets and Technology and Transmission and Distribution Strategy. The building owner is LINC Housing which has a 36-year history developing multi-family housing for elderly and low-income residents. The Electric Power Research Institute (EPRI) is supporting this project through the collection and analysis of monitoring data and the development of a test plan to examine demand response communications.

Results/Status

Inspection and review of the installed system – batteries, inverters and PV solar optimizers – has been completed. The inspection revealed a need for additional wiring, current transducers (CTs) and other troubleshooting before the integrated system can operate as designed. Project collaborators and vendors are working with SCE to obtain the necessary Permission to Operate (PTO), and the team is in the process of developing a full test plan and commissioning on site to enable the project to continue. Both EPRI and SCE are working with the SCE permitting group to facilitate the PTO in a timely manner so that work can be initiated.

Next Steps

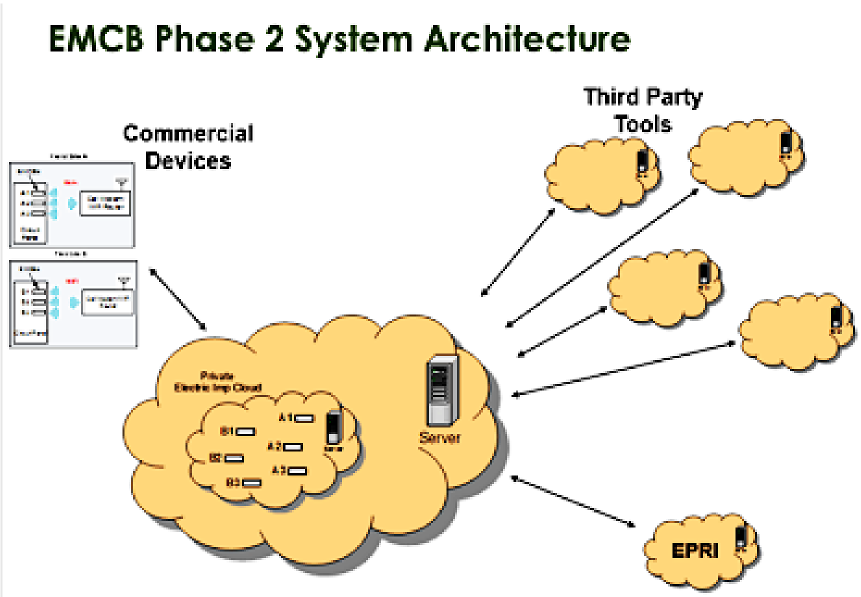
SCE project staff are planning to complete the troubleshooting and installation of auxiliary PV optimization equipment in collaboration with the BESS vendor, the installing contractor, SCE's interconnection group, and local electrical inspectors. A PTO testing date is pending as of this date. The EPRI team will be developing the BESS test plan based on the overall building capabilities and in coordination with the T&D planning team, which is expected to be conducted over several months in 2020.

DR19.01 Energy Management Circuit Breaker – Phase 2

Overview

This study is the second phase of an Energy Management Circuit Breaker (EMCB) joint utility project with EPRI, following Phase 1 that was completed in 2018. The main objective of this earlier project was to develop a prototype and field demonstration of communicating EMCB devices with demand response capabilities, and this phase is an enhancement of the hardware, software and functionality.

EPRI in this new phase of the project plans to expand on the EMCB technology to develop and increase enhanced demand response capabilities for 240VAC electric appliances such as water heaters and HVAC systems. This phase also plans on studying revised electric vehicle EMCBs for the latest EV charging networks.



In Phase 2, EPRI will examine and consider interconnection between the Eaton API and other interface architectures. One goal was to develop simple device management tools to commission and decommission EMCBs. Other technology advancements will provide EPRI opportunities to engage with other EMCB manufacturers and benchmark how they can provide similar functionality. With the emergence of back up storage systems paired with PV and optimal dynamic rate designs for "shift" in new construction, the project is on track to capture more benefits for SCE's emerging technology strategic initiatives.

EMCB Device

Collaboration

This is a collaborative project between SCE, Electric Power Research Institute, and at least six other utility companies such as Arizona Public Service, CPS Energy and FirstEnergy. Additional project sponsors have subsequently joined the project. The circuit breaker manufacturer is also investing resources in the development of the second phase of the EMCB data platform to enhance DR communications and facilitate larger loads such as EVs and other small commercial loads.

Results/Status

The data exchange platform has been demonstrated to project participants. Final review and quality control are set to be completed before the installation of the field devices. The application is additionally available on the Apple store. The project currently has over 200 devices ready for shipment and deployment.

The EMCB devices for the electric vehicles had been delayed due to design changes and the need for UL approval. The EMCBs will not be available for EVs until the third quarter of 2020, pending results of field testing and UL review.

Next Steps

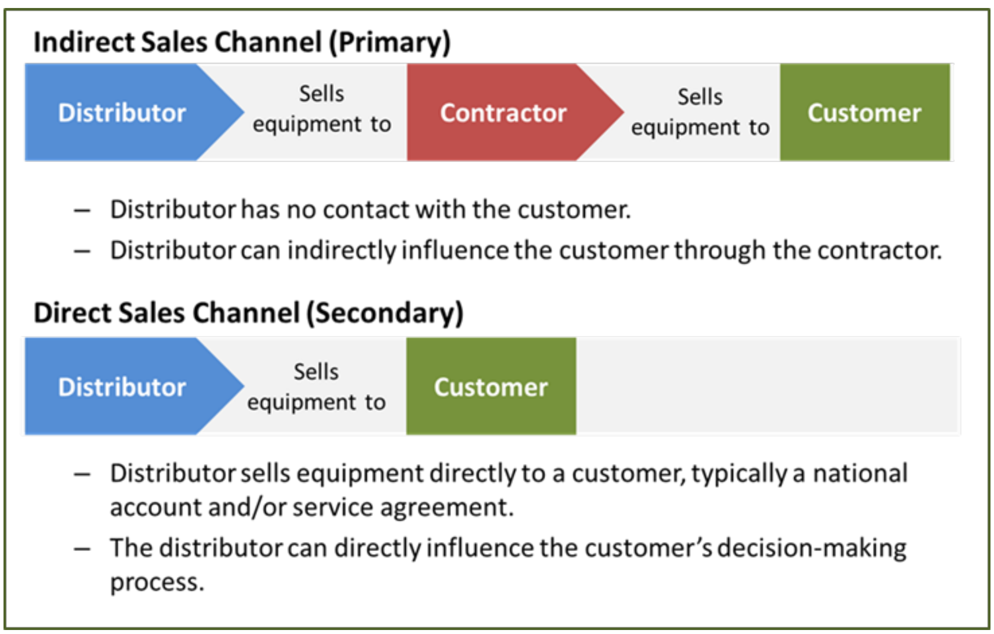
EPRI plans to procure the EMCB devices for installation, connectivity and testing of demand response capabilities. Once the electric vehicle EMCB devices are available they will be procured and tested for functionality and DR control in mid-2020.

DR18.10 Automated Demand Response-Enabled Solution Development for HVAC Distributors

Overview

The purpose of this project is to assess strategies to increase the commercial availability of OpenADR certified solutions to enable demand response by engaging HVAC distribution sales channels. This work builds on an earlier SCE upstream HVAC pilot that combined demand responsive controls with the high efficiency HVAC equipment. The pilot enrolled three HVAC distributors and two contractors who together installed three DR projects. At that time demand response equipment was still add-on equipment to HVAC, and not part of a complete sales package. OpenADR was still relatively new and not considered within the perspective of the HVAC distributors. This project is designed to develop an OpenADR sales channel.

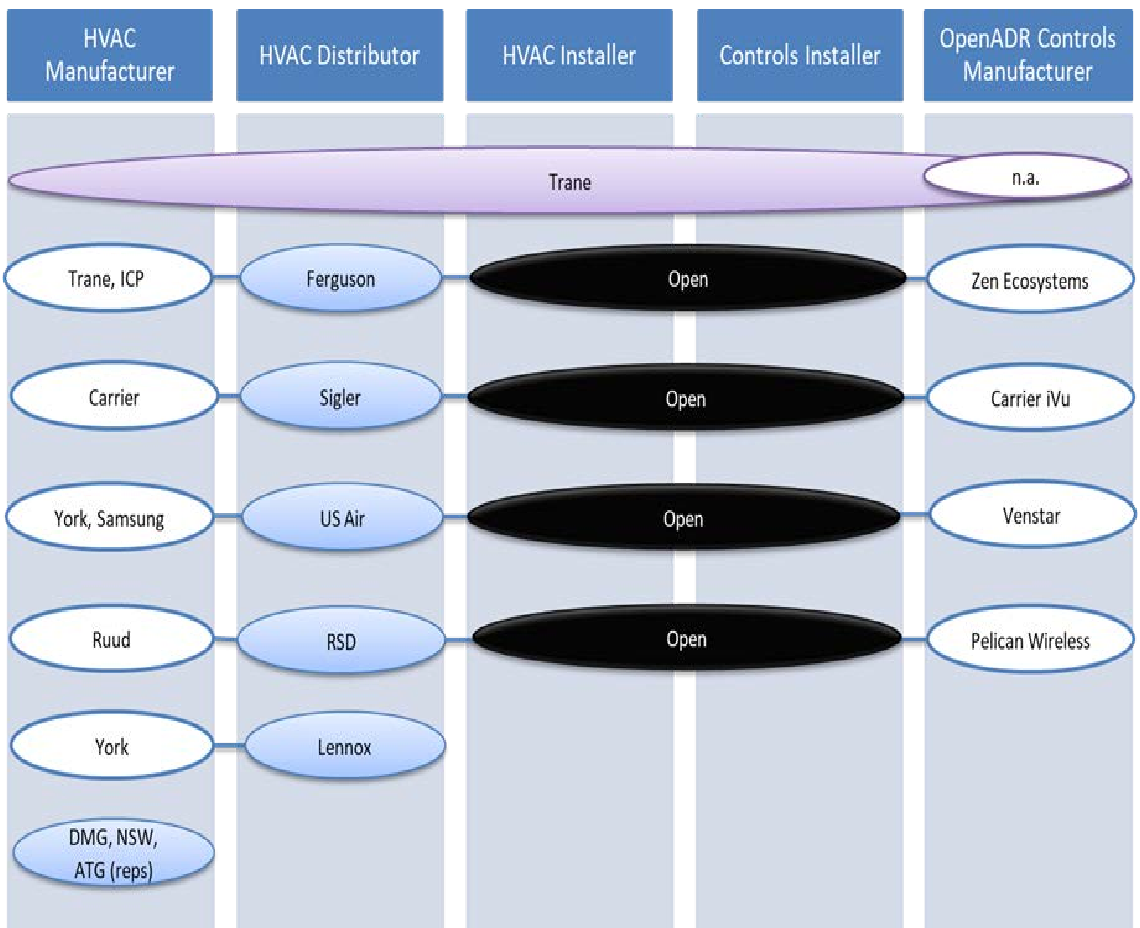
Sales Channels



The addition of demand response controls adds complexity to the HVAC equipment sales cycle and business proposition. For the promotion of OpenADR, it is necessary to understand HVAC equipment sales and how the delivery processes work to understand how ADR can be integrated. HVAC distributors and manufacturers have indicated a keen interest in participating in a new pilot study. Awareness of demand response among manufacturers and distributors working in California has grown substantially in the intervening years. Sales of cloud-based smart thermostats have grown significantly, and HVAC technology has adopted integrated controls that may be amenable to OpenADR.

This project will address the solutions market for HVAC distributors and manufacturers and develop strategies that can provide OpenADR solutions. It will build on the success of the earlier pilot by continuing the education process and renewing direct engagement with HVAC distributors and manufacturers.

The long-term objective of this work is to develop and deploy OpenADR-enabled HVAC control solutions through the sales channels. The project will provide this industry with clear messaging about the demand response value proposition. It will develop recommendations for an improved HVAC program that will assist the utilities to enroll interested participants. SCE will provide technical and program support to HVAC distributors to stimulate sales of OpenADR certified solutions with controls configured to receive utility demand response signals.



Existing Certified OpenADR Solutions

Collaboration

SCE is working on this project with its contractor Energy Solutions who is also managing the project to assist in AutoDR enabled solutions and with the HVAC industry in the development of case studies for OpenADR for HVAC distributors. The project is additionally working with the OpenADR Alliance and other DR stakeholders.

Results/Status

The first phase of the project assessed how ADR enablement can be facilitated with HVAC distributors. Six distributors were contacted, and four seemed to be particularly motivated – Ferguson, Sigler, Trane, and US Air Conditioning. These four distributors were the focus of SCE's effort to receive feedback to understand existing sales strategies and hear their ideas for increasing sales of certified ADR capable products. SCE is providing these distributors with ongoing information on the demand response industry, AutoDR programs and technical support to encourage OpenADR certification of existing ADR capable solutions.

The project also investigated the ADR-readiness of distributor OpenADR certified solutions. SCE assessed the ADR-capability for *out-of-the-box* equipment that is already OpenADR certified. These included Zen Ecosystem's thermostat (Ferguson), Pelican Wireless thermostat (RSD), Venstar thermostats (US Air Conditioning) and the i-Vu EMS (Sigler). Energy Solutions provided technical support to US Air Conditioning's main thermostat product Venstar through signal testing with SCE's and PG&E's DRAS and demonstrating how OpenADR compliance can be achieved.

Next Steps

SCE will be meeting with distributors in early 2020 to investigate how an ADR program could work with the upcoming CEC Title 24 proceedings. This will include a demonstration of HVAC ADR controls and the development of case studies. A final report with findings and recommendations is on track to be completed for the first quarter 2020.

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

Overview

This in-situ DER demonstration is located at a residential community developed by LINC Housing in the Willowbrook neighborhood of Compton, California called Mosaic Gardens. The building consists of 61 apartments with 1, 2, and 3 bedrooms, of which half are family housing, and the other half are reserved for formerly homeless and regular users of county services. This project showcases a host of DER technology advances that collectively can contribute substantially to the understanding of how DERs can meet the state's clean energy goals.

Architectural Rendering of the Willowbrook LIMF Project

There are many market barriers to the adoption of DER innovation in retrofitting multi-family buildings with solar and storage technologies, and this study, funded by the CEC will address cost, efficiency tradeoffs, and space constraints. These are all potential barriers to meeting the Zero Net Energy goals in both residential and commercial buildings. Advanced bifacial PV are being installed at this site with a target efficiency of about 23%. The project is studying use of a DER integration platform that is communications agnostic. The multi-port storage arrangement with smart inverter configurations enables a "shared savings" model.

The project, according to the CEC EPIC grant funding opportunity that was awarded to EPRI, is also looking at development and implementation of innovative testing techniques to evaluate new configurations for solar and optimization, and how DR dispatch strategies with the storage can be investigated for overgeneration mitigation. The use of DR strategies with storage is a new concept that will be investigated in this project, as part of the overall DER design in the building. Specifically, EPRI will be examining how the bi-facial PV and DC microgrid can be optimized with the DER integration platform that will receive CAISO dispatches.

Collaboration

SCE is co-funding the project through an EPRI supplemental program agreement as a co-funding commitment to a larger CEC grant. It is being designed and operated by EPRI under a contract with the California Energy Commission's EPIC program. Other partners include LINC Housing, Canadian Solar, E-Gear, GridScape, EPC Power, Staten, Kliewer and Associates, and OhmConnect.

Results/Status

The contractor completed drawings in mid-2019 and applied for local building permits. EPRI staff tested the storage, inverter and controls at the Solar TAC facility with assistance from Gridscape consisting of California Rule 21 Phase 1 requirements and site-specific requirements. However, a project contract (SNDA) has not been signed by a funding source of the project which caused the CEC to suspend activities in mid-December 2019 until contracts are resolved. As quickly as the SNDA can be signed, the overall scope of work will be initiated to drive milestones to complete the installation of the solar PV and battery energy storage systems which are being stored on site, ready for construction to begin.

Next Steps

The construction start date is still pending due to SNDA Execution between Los Angeles County Development Authority (LACDA) and LINC Housing. The project is significantly behind schedule, as the EPRI Special Project Agreement (SPA) final deliverable between SCE and EPRI is scheduled for Q1 2020. EPRI has completed the test plans for the research and taken delivery of some of the DER hardware. The CEC has placed a hold on the CEC-funded portion of the project until the full permitting is completed.

DR18.05 Residential Energy Storage Study

Overview

The overall goal of the project is to better understand how smart inverter APIs can demonstrate the monitoring and automated control of behind-the-meter residential batteries for grid support, demand response, and price elasticity to dynamic tariffs. This project will leverage SCE's investment in three Li-ion Batteries with SolarEdge smart inverters that have been purchased by SCE and are in the final stages of commissioning at three homes in the Moorpark area.

Typical Residential Battery Storage System

Distributed energy storage is regarded as one important solution to support increased distributed solar while minimizing operations stress on the distribution grid. SCE and other IOUs, the California Independent System Operator (CAISO), and the CPUC are exploring various approaches to dispatching and compensating behind-the-meter customers. In-home batteries with PV are growing in popularity.

The flexibility of the battery to either charge or discharge on short notice has a huge advantage as it can store energy for later discharge and thus accommodate more variable solar generation. This project demonstrates the application of retail tariffs with highly dynamic prices for energy storage and will explore automated dispatch of storage to address customer economics and grid operational issues.

Collaboration

SCE is leveraging three residential participants from a previous CEC EPIC grant project who have allowed the installation of the battery energy storage system (BESS) installed by a third-party systems integrator. The BESS includes a SolarEdge smart inverter system as well as the LG Chem RESU battery panel. Kliewer & Associates have facilitated the system commissioning and inspection of each of the homes and are currently developing a training module for the grid interactive API that will enable SCE engineering staff to schedule the systems for grid responsive flexibility testing.

Results/Status

The SCE project team has secured licensing for an enhanced version of the battery storage APIs. This required establishing an NDA between the contractor performing the work and the battery manufacturer. The project team will perform final commissioning and then begin to test the system for flexible load control capabilities. EPRI has been contacted as a potential partner in developing testing and optimization strategies once the API has been commissioned.

Next Steps

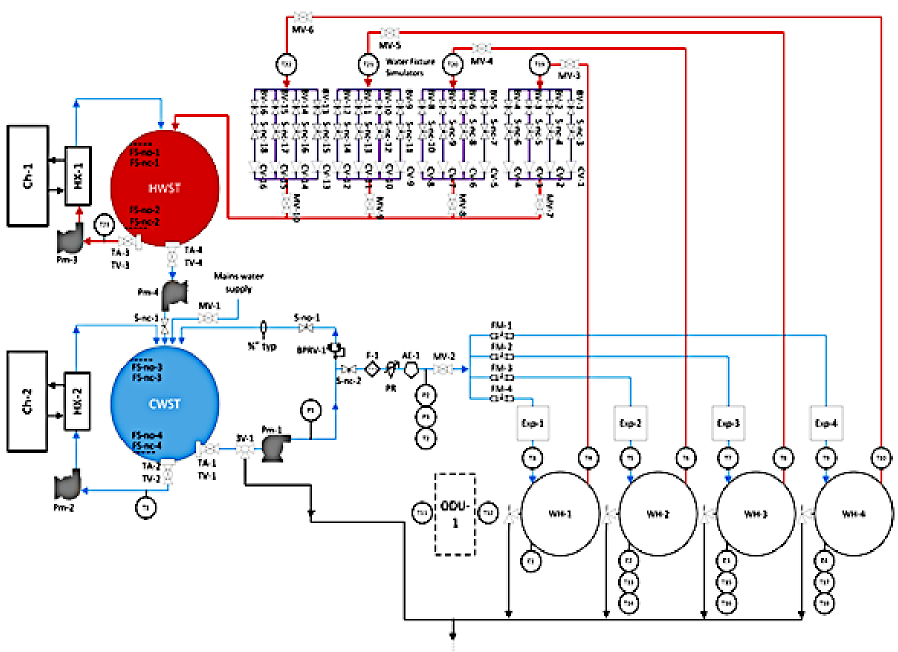
The next step will be commissioning the special APIs for the smart inverter so that price signal schedules that support SCE rates such as TOU-D PRIME can be uploaded into the battery systems and the smart inverters can communicate back the storage levels and charge/discharge schema. The team will then conduct a series of tests of the batteries for various scenarios of load control, load management, “shimmy” (charging them up and down) and backup power minimums. The cost impacts of different scenarios will be monitored as applicable. The tests are expected to be conducted during the months of 2020 with a draft report available in Q4 of that year.

DR18.04 Heat Pump Water Heater Systems

Overview

The project has been developed to facilitate a test environment for assessing how electric Heat Pump Water Heater (HPWH) systems can communicate under laboratory conditions to assess the flexibility modes of operation. SCE is developing a Flexible DR Communication Demonstration Lab for Water Heating Systems to provide the test conditions within a safe environment. The project will create a lab-demonstration for HPWH Open AutoDR testing using various transport media, and study communication capabilities and integration with the OpenADR 2.0a and 2.0b VEN architecture and CTA-2045 physical layer[1].

Lab Design Schematic (LDS-1A)



Load shape and energy demand case studies for HPWH are based on a wide range of water usage and temperature set point profiles. The team will assess demand response value propositions for developing flexible load shifting strategies and their effect on water supply, water temperature, and energy usage and demand.

[1] CTA is the Consumer Technology Association's standard on modular communications interface for energy management.

The test plans include case studies for customer-to-grid integration scenarios by examining how HPWHs can react to dispatch and shift signals and the effect on temperature from water draw during times of high and low water usage. The project test bed accommodates four water heaters at once and will be able to impose realistic hot water draw events for demonstration purposes. The project will study 24-hour profiles for performance evaluation. In this manner, the test bed will serve as both a showcase for emerging DR enabling technology for HPWHs and a highly capable working laboratory for long term performance studies.

Collaboration

The demonstration lab is being installed in SCE's Irwindale Energy Education Center (EEC). It will serve as both a fully functioning working lab and an opportunity to engage vendors and others to assess HPWH technologies. This project will coordinate its research findings and inform the grid responsive HPWH investigations underway in the San Joaquin Valley (SJV) Electric Pilot and the Demand Response Pilot for Disadvantaged Communities (DR DAC).

Results/Status

By the third quarter of 2019 the lab design and materials procurement were completed, and construction/installation began. Major equipment is slated for completed installation in the first quarter of 2020. Installation of lab supervisory controls and data acquisition (SCADA) systems are scheduled for completion in the second quarter of 2020 and testing will commence at that time.

Next Steps

Complete installation and configuration of the laboratory in underway. Preliminary testing will take place in the second and third quarters of 2020. The potential for central multi-family systems configuration will be evaluated at that time. This laboratory may potentially be expanded to investigate multi-family HPWH applications for demand response functionality.

DR18.03 Connected Pool Pump Market Assessment

Overview

The Connected Pool Pump (CPP) Market Assessment project is studying the market potential of pool pumps as a flexible distributed demand response resource. The pool pump industry has undergone technological advancement that are well aligned with new opportunities for demand response such as “shift” and “shimmy”. This project will start with a literature review of previous pool pump demand response programs. It will assess current pool manufacturer technologies and characterize the supply chain. The objective is to quantify the flexible resource potential in SCE’s territory by examining how new types of pumps and motors can be adjustable.

Pool Pump Equipment Elements

The scope of this activity is to characterize the SCE residential pool pump market with information on shipments, supply chain, and influential market actors. The team will review distribution market channels in the SCE territory through interviews with manufacturers and select distributors, retailers and installers as needed. The next step will be to quantify the technical potential of connected pool pumps as flexible resources in the SCE territory.

Collaboration

Energy Solutions is leading the project research team and collaborating with the Electric Power Research Institute (EPRI). EPRI has multiple ongoing technical assessment projects on communicating pumping technologies that can support flexible demand response. SCE’s EM&T group is working with EPRI and other utilities to gather data on what other research is in progress in this area.

Results/Status

There are minimal technical or operational constraints to using connected pool pumps as flexible demand response resources. Preliminary market assessments find that connected pool pumps are an ideal resource for three of the four types of demand response: Shape, Shift, and Shed. They are adept at performing load shifting under TOU rates that reflect grid needs. This contrasts with other demand response measures such as lighting that are unable to shift load to other times of the day. Shimmy at a longer time period (hourly) is feasible, but not on a minute by minute basis due to physical constraints of the pumping systems. Energy Solutions has interviewed manufacturers, pool installers and service companies to assess planned technical developments that include new types of communications systems, APIs, and advanced pool/spa/water feature systems.

Next Steps

The project team is finalizing details of the literature review of previous pool pump demand response programs that have been conducted by other research agencies and utilities in order to benchmark the current plan to implement a future field test. The team is in the final stages of assessing current pool manufacturer communication technologies, characterizing the supply chain of installers and retail outlets, and helping to quantify the flexible resource potential in SCE territory on a new construction and retrofit basis. The Final Report of the market assessment will be complete in the first quarter of 2020.

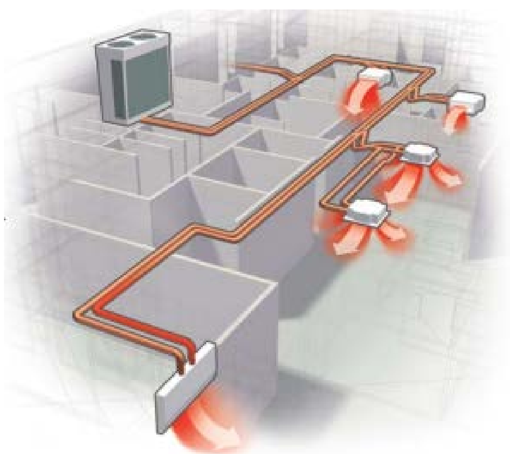
DR17.18 DR Control with Variable Capacity Commercial HVAC System

Overview

This project will evaluate and demonstrate new potential for otherwise unrealized demand response capability from new-to-market variable capacity commercial HVAC systems in California. SCE and their customers will benefit from this effort by unlocking a new resource for both utility-based demand response and customer directed demand management. Variable capacity commercial HVAC systems are primarily associated with energy efficiency and superior customer comfort. Variable refrigerant flow (VRF) systems and advanced roof top units include variable speed compressors, electronic expansion valves and a multitude of refrigerant management features to match output of the HVAC system to load on the building.

One key element in all these advancements is the use of sophisticated controls. These systems have extensive instrumentation and processing power that acts as its own data cloud. With extensive on-board measurement and high on-board processing power the system always seeks to operate in an optimized fashion providing masterful comfort with maximum efficiency.

VRF System Diagram



There is renewed interest across the utility industry in enabling technologies that can achieve both demand response and energy efficiency. Variable capacity systems, with their on-board instrumentation and communications capabilities, are candidates for implementing both demand response and energy efficiency at the same time.

While energy efficiency measures have been in place for such equipment, demand response capabilities can push the technology further into the mainstream market. This market is dominated by rooftop units, split systems, and chiller/boiler combinations. Commercial HVAC systems are a coincident load (peak power draw occurs during the hottest days) and thus are a prime candidate for DR, while also being an efficient technology during normal operation.

This project was undertaken to determine the extent to which variable capacity commercial HVAC systems can provide demand response services by reducing (or increasing) power draw. The project is defining use cases for this advanced demand response capability. Candidate systems are being integrated with open protocols like OpenADR as an application layer. The project will provide operational data from systems installed in the field that have advanced demand response capabilities and provide data and analysis to fulfill the needs of SCE's program implementation of advanced commercial HVAC demand response.

Collaboration

Multiple stakeholders came together to design the project, provide technical support, and ensure project success though meaningful engagement. SCE and EPRI prepared a demand response test and analysis plan that takes into consideration demand response programs that are available today. Data collection was undertaken at two sites. The project team partnered with available DR programs with two manufacturers for acquiring hardware and technical support.

Results/Status

Demand response targets have been formulated based on review of relevant HVAC equipment standards (e.g., AHRI Std. 340/360, ANSI/AHRI Std. 1230). In addition, AHRI 2019 Standard 1380 for "Demand Response through Variable Capacity HVAC Systems in Residential and Small Commercial Applications", developed with broad industry participation has been used extensively as a baseline. A few additional demand response targets have been added based on consideration of larger equipment capacity and more diverse applications served by commercial unitary HVAC systems. Data gathering has been concluded, and data reduction and analysis are currently being performed.

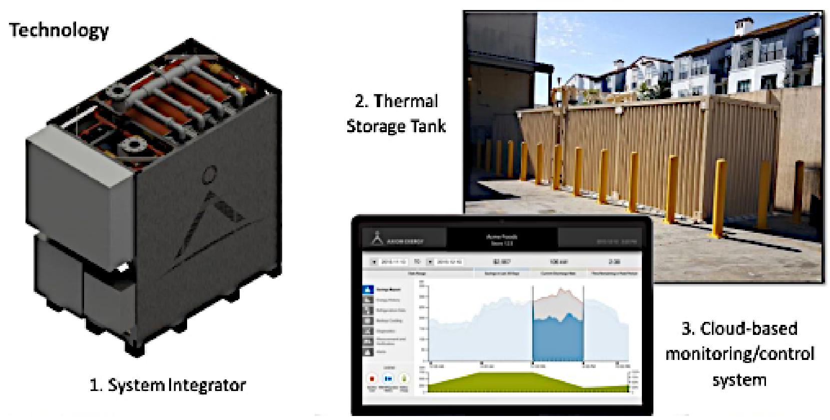
Next Steps

The results will be shared with customers and other interested parties. The data analysis will be complete in the first quarter of 2020 and a project report will be available in Q1 of 2020. The final report will be posted to the ETCC website.

DR17.05 Refrigeration Battery

Overview

SCE's EM&T team partnered with SDG&E's Emerging Technologies division, kW Engineering, and Axiom Exergy to study the potential of a "Refrigeration Battery" thermal energy storage system for load management and demand response. The battery provides permanent load shifting for commercial refrigeration systems, similar to the HVAC thermal energy storage systems used for permanent load shifting at many facilities with central plants. This study is examining the DR potential of thermal storage using advanced communication systems that can facilitate either real time or day ahead dispatch strategies. By partnering with SDG&E and others, overall costs of the study are leveraged among the teams.



The system under test is a plug-and-play retrofit for central refrigeration systems in supermarkets and other refrigerated facilities. It enables installed refrigeration storage for later use by freezing a tank of water with common additives. The system as designed first reduces supermarket electricity bills by shifting refrigeration loads away from on-peak afternoon hours (when electricity prices are typically higher) to off-peak night hours (when electricity prices are low). Second is through refrigeration backup. The system can be configured to keep food cool during power outages, protecting against catastrophic food spoilage events or acting as a buffer to temperature swings during stocking. Acting as a form of thermal energy storage, there may be an opportunity for "shift" on short term.

The research team has engaged an engineering contractor to provide M&V services at a selected grocery store to evaluate the systems performance claims. At this site the team is assessing the annual energy savings (and kW demand) associated with the storage technology. The next step is confirming each utility's rates when electricity costs are lowest and highest, and deploying it when electricity costs are highest to offset as much of the on-peak demand charge as possible. A technology assessment report will quantify specific claims to permanently offset peak load with little or no impact to the refrigerated product. A final technology assessment report will detail permanent load shifting and energy saving capabilities based on M&V analyses.

Collaboration

This project was initiated with the ETCC, and includes utility stakeholders from SCE, PG&E, SoCalGas, and SDG&E. Additional collaborators are the CEC and municipal utilities SMUD and LADWP. Measurement and verification services will be performed at a grocery store in San Diego to evaluate Axiom's specific performance claims. SCE's TTC will observe the installation to affirm the M&V approach and opportunities for flexible demand response. In addition, this analysis will consider refrigeration best practices and policies from the CEC's Title 24 and ASHRAE.

Results/Status

The site selection and contracts were finalized with SDG&E. The next step was the battery system installation. Data collection was completed in the last quarter of 2019. A draft report will be completed within the next few months and should be available in Q1 2020.

Next Steps

The customer has demonstrated strong interest in the Refrigeration Battery system as a potential new technology solution to both save its overall costs in energy and demand, and also to enhance its role in demand response program opportunities. This application can facilitate comparisons between the cost and value created from diverse sets of flexible loads. Future opportunities for more flexible demand response "shift" operations will be examined in the context of future demand response program models for this customer sector.

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

Overview

The research goal of this project is to demonstrate the design and installation of advanced DER measures for all-electric Zero Net Energy homes within the multi-family housing sector. A secondary objective is to study how ZNE homes in this segment perform with solar and thermal storage. The mission will be to develop the strategies for effective integration with the electric grid. This project will include load management and load modifying end-use operation, along with energy efficient technologies such as smart air-conditioning controls and other end-use measures. Both demand response “shift” and flexibility capabilities are being assessed.

Architectural Rendering of ZNE Multi-Family Housing System

Project outcomes offer guidance for the development of the next iteration of buildings that will meet the planned 2020 and beyond requirements of the Title 24 California Energy Code for OpenADR communications and flexible appliances. Outcomes from the project will offer neighborhood planning tools and assistance to developers and builders engaged in constructing all-electric master communities interested in ZNE construction. These buildings will ultimately feature built-in demand response capabilities and support utility distribution system planning through updates of the T&D planning models for sizing transformers and circuits.

The developer of this project (Meritage) will be installing an integrated all electric measure package consisting of numerous energy technologies for both customer interest and to enhance desirability and comfort:

- Induction cooktops
- Open ADR-connected API HPWH
- Heat pump clothes dryers
- High-performance windows
- Variable refrigerant-flow heat pumps
- Network-connected smart thermostats with DR capabilities
- Ducts located in conditioned attic spaces
- Voice assisted smart home energy management systems
- Smart intermittent ventilation systems
- Electric load panels, with circuit energy monitoring
- Integrated grid distribution planning for ZNE
- Integrated DR controls to improve electric load shaping

This project will additionally provide feedback on the implementation of voice-activated smart-speaker demand response control of the in-home technologies and grid-interactive heat pump water heaters.

Collaboration

This project is a collaboration between SCE, EPRI, and Meritage House which is a builder and seller of multi-family housing. SCE is providing technical assistance with design, construction management, and demand response innovation review.

Results/Status

By year end 2019, a total of 14 of the 22 homes ready for occupancy were sold. Twenty additional homes will be completed by the second quarter of 2020. Monitoring equipment has been installed and commissioned in all occupied residences and is already collecting data.

Next Steps

Performance data monitoring will continue for a year after the housing units are occupied. Because sales and construction have been slower than expected, the final report is now expected by year-end 2021. After review and approval, the final report will be posted to the ETCC website.

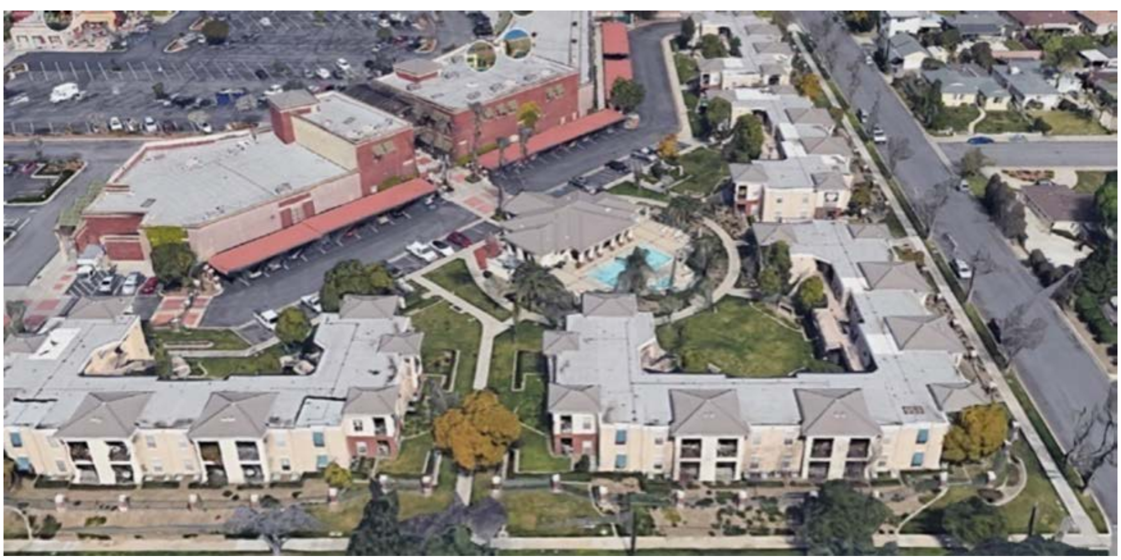
DR17.02 Customer-Centric Approach to Scaling IDSM Retrofits

Overview

SCE is the host utility for an EPRI project that was awarded through an Electric Program Investment Charge (EPIC) solicitation, "Scaling Customer-Centric Energy Efficiency Retrofits with Integrated Demand Side Management."

California's Building Energy Efficiency Standards are moving the state closer to achieving its ZNE goals of all new low-rise residential buildings in 2020. New commercial buildings need to be ZNE compliant by 2030. Achievement of these goals will represent a major improvement in energy efficiency in the construction industry. These building practices offer occupants energy, cost, and GHG reduction opportunities. Demand response load management strategies can also play an important role in supporting ZNE.

The goal of this project is to formulate, demonstrate, and evaluate an innovative retrofit method for designing IDSM/ZNE packages that could enable scaling both demand response and energy efficiency measures within existing low-income communities.



Senior Apartments with IDSM Retrofits

This combined demand response and energy efficiency project is intended to demonstrate IDSM and ZNE solutions in the multi-family sector. An existing LIMF property is undergoing both demand response and energy efficiency retrofits. The EM&T focus of the research is the operation of smart thermostats for HVAC optimization and load management in a multi-family senior living environment.

This project could establish a foundation for the creation of new IDSM retrofit solutions to meet ZNE goals and the creation of new IDSM retrofit guidelines for residences in low-income communities. The team will develop a list of technologies that create customer-centric packages for future retrofits that may include in-residence technologies to enhance multi-family demand response capabilities.

Collaboration

The collaboration involved multiple stakeholders, including SCE, CEC, EPRI, and LINC Housing, which is an affordable housing owner and operator who has enthusiastically participated in testing new technologies and methods at their facilities. SCE serves several roles as the host utility, technology lead, grid-side lead, and subject matter expert. Sustainable engineering consulting services are provided by BIRAenergy.

Results/Status

Construction work is complete for the retrofit measures, referred to as the Energy Efficient Retrofit Package (EERP). As part of the EERP, each apartment underwent HVAC retrofits. Data collection devices have been installed and commissioned using circuit-level plug load data collection devices. SCE is particularly interested in how the new appliances and the smart thermostats have provided system optimization for load management in response to TOU rates. Results of the study are not yet available because the report is still in progress at this time.

Next Steps

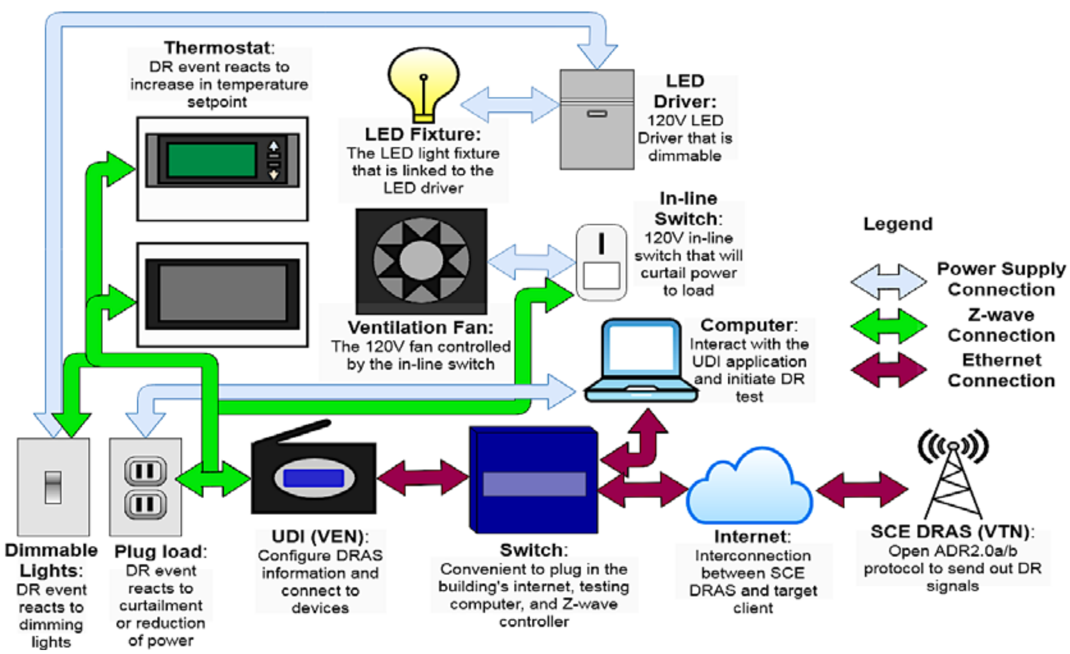
The retrofit construction at the site is now complete, and post–retrofit occupancy data has been gathered and analyzed. These data are on-track to provide information to various project and industry stakeholders to demonstrate appropriate ZNE, DR, and IDSM technologies. The final report draft is scheduled for delivery in the third quarter of 2020. Following the final approval of the report filed with the CEC, the public version of the project report will be posted on the ETCC website.

DR17.01 SCE OpenADR Test Lab Development

Overview

Demand response controls have been an element of the California energy code since the 2008 Building Energy Efficiency Standards, Title 24, Part 6, and became effective in 2010. However, there remains a gap in knowledge and technology adoption in the building industry limiting code compliance. This project was designed specifically to establish a demand response technology test and training environment in order to better engage with its customers, building industry technicians and contractors, end-use equipment manufacturers, and demand response technology developers to enable OpenADR market transformation.

Conceptual DR Network Infrastructure



A multi-use technology test lab for emerging Auto-DR products was developed at the SCE Technology Test Center (TTC) in Irwindale, California. A suite of test rigs provides the hands-on development of ADR products that enable customers and trades to participate in DR programs. The ADR Test Lab was designed for maximum flexibility, allowing continuous rotation of products that enable varying configurations of different ADR strategies and devices.

Multiple Virtual End Nodes (VENs) were installed with capability to accommodate multiple test scenarios to both examine and demonstrate how manufacturers of various technologies could come together to explore their DR communications potential and provide a proving ground for new DR-enabling technologies, where both commercially available and certified OpenADR products could demonstrate their capability.

Collaboration

SCE has asked industry partners engaged in DR technology to collaborate in two primary areas. The first is building a SCE ADR lab where vendors can submit their equipment for ADR functionality and strategy testing. The lab has cross-cutting Virtual End Nodes (VENs) with various capabilities and DR strategies to which the SCE lab can attach devices and select scenarios for testing ADR capability at the equipment level, without a gateway.

The partners recommended building a hands-on ADR demonstration that provides an interactive learning experience of ADR integration with the IoT. Its initial focus will be on ADR systems interaction, where the customer can learn about the equipment and the commissioning necessary for OpenADR to participate in flexible DR rates, incentive programs, and possible market resource opportunities.

Results/Status

Phase 1 of this project consisted of preliminary research on Z-Wave, Wi-Fi, and BACnet communication protocols and load management capabilities. The purpose was to explore the viability of creating a universal lab to test demand response load reduction strategies. Some high-level considerations for Z-Wave-enabled, Wi-Fi-enabled, and BACnet DR-controlled devices are offered here. Due to the proven record of Z-Wave load control devices, it was chosen to establish the test lab baseline, and as the first proof-of-concept build.

Next Steps

Several capabilities were identified as potential targets. First is an interactive DR VEN installation learning experience, with outputs to show various AutoDR measures and their control capabilities. The thermostat, lighting control, and standalone VENs link to one DRAS account. A second example is a function for customers to create events on the DRAS, and select which client, or which combination, will initiate load shed. The project’s remaining scope will be revisited, along with opportunities for new types of demand response activities and priorities in the second quarter of 2020.

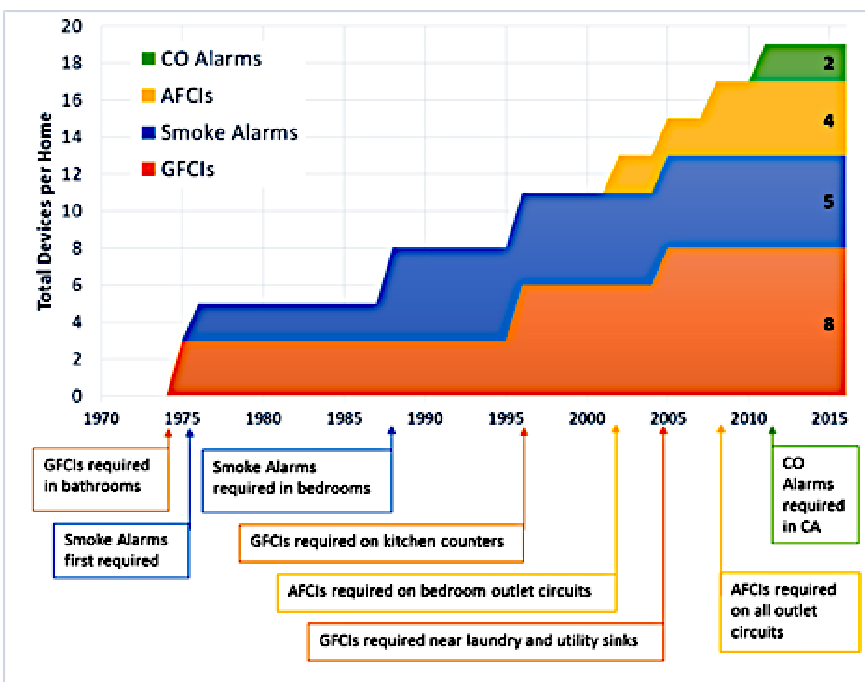
4. Projects Initiated Q3 – Q4 2019

DR19.07 Measuring Builder Installed Electrical Loads

Overview

The research objectives of this project are to examine opportunities for load management of new construction hard wired loads that could possibly be managed to reduce their small but growing impact on future overall residential energy load shapes. The first step is to collect data on electricity consumed by equipment in newly constructed homes. Short-term, whole-house power measurements will be taken from new homes during a relatively short time period between the completion of construction and the move-in of the homeowner. Numerous devices are being installed in new homes, sometimes required by health and safety codes and other times to make a new house more attractive to buyers.

Growth in Life/Safety Devices in New Homes



Anecdotal data from an ongoing CEC EPIC project suggests that builder installed electrical loads are contributing as much as 1,300 kWh/year in total power usage in new homes, even before occupants have moved in. No information is currently available to assess how this impacts load shape. This first phase of research is needed because this aspect of residential energy use has not been yet been carefully studied. Also, as new homes receive PV, smart inverters, energy storage, and smart car charging systems, the impacts of these load could increase.

Collaboration

This project includes collaboration with internal SCE groups, including Emerging Technologies and the Business Customer Division. Stakeholders have an interest in finding demand responsive solutions for builders that will make the homes they construct less energy intensive while managing loads to minimize grid impacts. The study will be conducted with researchers located at the advanced buildings section of the LBNL facility and coordination with builders through SCE field services.

Results/Status

This project was initiated in November 2019, and the final scope and vendor proposals are under review. The overall sample and test plan will be finalized at the end of 2019 once the contract is executed. Installations are expected to begin in the second quarter of 2020 once customer recruitment is completed.

Next Steps

The next steps are to finalize the work scope and M&V plan with the primary investigator LBNL, under contract to EPRI. Recruitment of builder sites will begin in the first quarter of 2020, and a final report is expected by the end of 2020.

DR19.04 Evaluation of Direct Energy Savings and DR Potential from PCM for Cold Storage Cooling

Overview

The project is intended to determine the effectiveness of phase change materials (PCM) technology to act as a means for refrigeration facilities to "shift" their energy usage and electrical demand. Thermal storage has been examined in various ways to provide various durations of "shed" for traditional demand response programs, but PCM has not typically been used as a tool for enabling other modes of demand response that may provide longer durations.

This technology utilizes the existing walk-in space for storing frozen food and acts as an element of the thermal storage mass by adding more storage "load" via sealed modules on top of the storage racks. The PCM system combines phase change materials designed for cold storage applications of -10º to 0º F (-23º to 18º C) and modified refrigeration system control logic.

PCM Technology Installed in Warehouse

The project test plan will assess both the value of the PCM as a storage media that provides "shift" and possibly more flexible refrigeration compressor cycling. At least four tests with large walk-in freezers will be selected. The project team will quantify the value of the PCM technology under various demand response scenarios.

It will evaluate its success at maintaining stored food temperature limits and document any impacts on energy performance.

Test scenarios will determine minimum and maximum demand reduction for midday, evening and nighttime periods for each season, and will study when the maximum and minimum demand reductions occur.

The project will confirm the advantages of constant availability of the PCM on the volume of food storage space. For example, how much time can the refrigeration system be off for certain volumes of cold storage? This information will offer information about “hour-ahead” demand response strategies. The project will assess the response that could be expected from various pricing signals to the customer and the distribution system.

Collaboration

The first test is being overseen by SCE refrigeration engineers at a refrigerated food warehouse in Rancho Cucamonga, California. The PCM will be provided by Viking Cold Storage. D+R International engineers will be installing the monitoring equipment, coordinating the DR scenarios, and reporting on the results.

Results/Status

Properly engineered PCMs should theoretically be able to manage how energy is consumed in cold storage facilities. PCM is a low-cost method for thermal storage that can help manage everything from door openings, to flexible demand response opportunities to reduce or increase electrical demand, to the need to shut off refrigeration systems altogether for an extended period. A report will be produced that describes any discoveries and drawbacks with PCM paired with controls for demand management. These results should demonstrate how refrigeration can be managed to reduce usage during demand peaks, particularly the 4-9 pm period.

Next Steps

The anticipated start for this project is late in the first quarter of 2020. Interim results will be provided throughout the duration of the project. Data collection will be complete about 12 months from the official start of the project and project results will be available one month later.

5. Budget

The following table represents the total expenditures for SCE's 2018-2022 EM&T authorized budget. These values are based on the authorized funding and 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, January 20, 2020. Values do not reflect commitments for projects, including those described in this report, which have been scoped and contracted, but not yet executed or monies that have not been spent.

Southern California Edison's Emerging Markets and Technology Program (D.17-12-003)	
Approved 2018-2022 Budget	$14,610,000
Budget Spent to date	$ 7,465,834
2018-2022 Budget Remaining	$ 6,964,166