

Demand Response Emerging Markets and Technology Program

Semi-Annual Report: Q1 – Q2 2026

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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
AI	Artificial Intelligence
AMI	Advanced Metering Infrastructure
API	Application Program Interface
ASHRAE	American Society of Heating and Air Conditioning Engineers
ASP	Automation Service Provider
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
BTO	Building Technology Office
C&S	Codes and Standards
CAISO	California Independent System Operator
CARE	California Alternate Rates for Energy
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
DERMS	Distributed Energy Resource Management System
DF	Demand Flexibility
DOE	Department of Energy
DP	Dynamic Pricing
DR	Demand Response
DRAS	Demand Response Automation Server
DRLIMFH	Deep Retrofits in Low-Income Multi-Family Housing
DRMEC	Demand Response Measurement and Evaluation Committee
DRRC	Demand Response Research Center
DSM	Demand-Side Management
DSRIP	Demand Side Resource Integration Platform
EE	Energy Efficiency
EEC	Energy Education Center
EERP	Energy Efficient Retrofit Packages
EMIS	Energy Management Information Systems
EM&T	Emerging Markets & Technology
EMS	Energy Management System

EPA	Environmental Protection Agency
EPIC	Electric Program Investment Charge
EPRI	Electric Power Research Institute
ESA	Energy Savings Assistance
ET	Emerging Technologies
ETCC	Energy Transition Coordinating Council
EVSE	Electric Vehicle Supply Equipment
EVTC	Electric Vehicle Test Center
EWB	Electric Water Heater
FDD	Fault Detection and Diagnostics
FERC	Federal Energy Regulatory Commission
GFO	Grant Funding Opportunity
GHG	Greenhouse Gas
GIWH	Grid Integrated Water Heater
GWP	Global Warming Potential
HAN	Home Area Network
HEMS	Home Energy Management System
HFC	Hydrofluorocarbons
HIL	Hardware-In-The-Loop
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air Conditioning
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
LF	Load Flexibility
LIMF	Low-Income Multi-Family
LM	Load Management
LOC	Letter of Commitment
M&V	Measurement and Verification
MF	Multi-Family
MIDAS	Market Informed Demand Automation Server
MPC	Model Predictive Control
MSO	Meter Services Organization
MW	Megawatt
NDA	Non-Disclosure Agreement
NEEA	Northwest Energy Efficiency Alliance
NEM	Net Energy Metering
NMEC	Normalized Metered Energy Consumption
NPD	New Product Development & Launch
OCST	Occupant-Controlled Smart Thermostat
OEM	Original Equipment Manufacturer
OP	Ordering Paragraph
OADR	Open Automated Demand Response

PCM	Phase Change Material
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
PSPS	Public Safety Power Shutoffs
PTR	Peak Time Rebate
PV	Photovoltaic
QI/QM	Quality Installation/Quality Maintenance
RDD&D	Research Development, Demonstration and Deployment
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
SPA	Supplemental Project Agreement
T-24	Title 24 (California building energy efficiency code)
TES	Thermal Energy Storage
TRL	Technology Readiness Level
TOU	Time of Use
TPOs	Third-party Technology Owners
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
VTN	Virtual Top Node
WW	Wastewater
WWTP	Wastewater Treatment Plant
XML	Extensible Markup Language
ZNE	Zero Net Energy

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1. Summary

Southern California Edison (SCE) submits this Q1 – Q2 2026 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. In that Decision, the CPUC stated:

“In D.08-06-027, the Commission determined that given the continuing evolution in DR techniques, enabling technologies, and evaluation methods, California benefits from investing in research and development that will encourage the adoption of cost-effective DR. We find it reasonable to continue funding Emerging Technology projects for all three utilities. Our review of utility Emerging Technology proposals indicates that the programs address appropriate technologies needing evaluation and appear reasonable in terms of budget requests.”

That Decision also 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. Those reports have been submitted in compliance with D.12-04-045 and are available at the DRET website.¹

OVERVIEW

Emerging technologies assessment programs are designed to respond to developments in markets and technologies faster than DR customer enrollment programs with strict cost-effectiveness thresholds. These relatively small-scale assessments provide utility staff, policymakers, and industry partners with information needed to advance toward the envisioned energy future and rapid deployment of proven, cost-effective technologies. Yet, they are critical for the future of DR program design and implementation, and this is the foundational rationale for the initial authorization of the SCE DR EM&T program by the CPUC.

The SCE DR EM&T program, in compliance with CPUC directives, is designed to accelerate the commercial deployment of innovative new DR technologies, software, and system applications to enable cost-effective customer participation and performance in SCE’s programs, tariffs, and grid operations. The program conducts activities related to technology research, market studies, the intaking of emerging consumer technologies, scaled demonstrations, equipment field trials, and laboratory tests. These activities help enable the high-tech and consumer market participants to adopt methods and standards for customer participation in DR programs, and the

¹ <https://www.dret-ca.com/emtcomplianceports/>

program also advocates with stakeholders to enhance emerging markets for the continuous improvement in DR technological innovation.

The benefit from these investments in DR research enables customers in all sectors and income levels to meet their future energy needs in a cost-effective manner that ultimately results in enhanced grid reliability and energy affordability for all. These benefits can accrue in the near term for local grid needs and current DR programs, and through the development of new models of programs and technologies, help develop the foundational capabilities required for the longer-term future needs of SCE customers and the California electric system.

The EM&T program activities help to identify and mitigate non-technology market adoption barriers that impede or restrict SCE customers and the overall consumer industry from understanding and adopting effective DR behaviors and performance measures. The program's technology adoption influence strategy includes delivering upstream industry market facilitation to bring DR awareness to the consumer industry so that they develop an affordable flow of "off the shelf" enabling technologies that customers can adopt for DR program participation. This includes, through technology-driven DR standards advocacy, codes and standards adopted by the California Energy Commission that now brings DR innovation to the consumer markets, enabling overall cost savings and new technologies for all sectors.

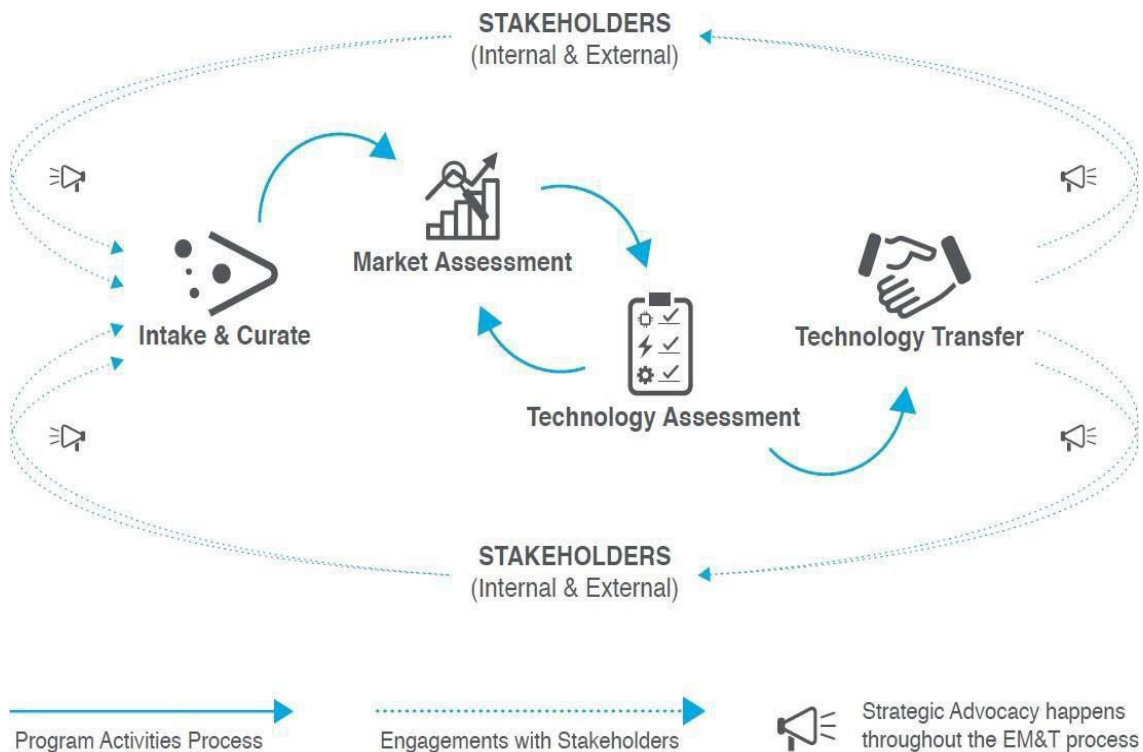
INVESTMENT CATEGORIES

The EM&T program's core investment strategies align with the guidance from D.17-12-003, and the program strategies facilitate DR-enabling technology market adoption through education, in-situ field testing, assessing customer perspectives, understanding of market barriers, and technology transfer, resulting in increased customer participation in DR programs and tariffs.

The five EM&T core investment strategies are as follows:

- Intake and Curation: Identifies studies, projects, or collaborations for inclusion in EM&T's portfolio and selects which ones to fund based on a well-informed understanding of the broader industry context. Many of these intakes are curated through engagement with start-up companies and established industry stakeholders developing new products and services.
- Market Assessments: Create a better understanding of the emerging innovation and developments of new consumer markets for DR-enabling technologies and an awareness of consumer trends for smart devices. These include mass market consumer smart technologies and behind the meter distributed energy resources (DERs) such as heating and cooling systems, batteries, and electric vehicles.

- **Technology Assessments:** Assess and review the performance of DR-enabling technologies through lab and field tests, and demonstrations designed to verify or enable DR technical capabilities. Due to the nature of specific DR program performance needs, many DER systems have the ability to both provide their core functionality as well as added value as a DR resource.
- **Technology Transfer:** Advances DR-enabling technologies to the next step in the adoption process, including raising awareness, developing capabilities, and informing stakeholders during the initial stages of emerging technology development for potential DR program and product offerings.
- **Strategic Advocacy:** Actively supports key market actors to integrate DR-enabling emerging technologies into their planning, including promoting DR-enabling technologies for program adoption and supporting the development of open industry standards (Note: Strategic Advocacy is embedded in all the EM&T projects and occurs throughout the stakeholder process).



EM&T Program's Current Portfolio Investment Approach

The learnings and results from each activity, study, and assessment type are made publicly available and are effectively disseminated via webinars and in-person summits and forums to energy market stakeholders who can act upon these results (including investors, technology developers, established manufacturers, industry and customer trade groups, local governments, and policymakers).

CURRENT EM&T INVESTMENTS

The following table lists the EM&T projects described in this report that were initiated, in-progress, or completed during the Q1 – Q2 2026 period. The table also identifies each project with the EM&T Investment Category that each project addresses to facilitate the continued development of DR emerging technologies.

Project ID	Project Name	EM&T Investment Category
Projects In Progress		
DR22.02	HP-Flex: Next Generation Heat Pump Load Flexibility DR (GFO-19-301)	Market Assessments Technology Assessments
DR23.01	DR-TTC Dynamic HVAC Test Chamber	Technology Assessments Technology Transfer
DR24.01	Behind the Meter Optimization of Load Technologies (BOLT) Study	Market Assessments Technology Assessments
DR25.03	EPRI IAW FlexHub SPA (GFO-23-316)	Technology Assessments Technology Transfer
DR25.04	EPRI LAUSD-FLEX SPA (GFO-23-309)	Technology Assessments Technology Transfer
DR25.06	EPRI FLEX DR 2.0 SPA	Market Assessments Technology Assessments
DR25.07	EPRI Smart Panel Field Study SPA	Market Assessments Technology Assessments
DR25.12	EPRI Flex Refrigeration SPA (GFO-23-301)	Technology Assessments Technology Transfer

EM&T Program Project Investment Categories

SCE works collaboratively with the electric California Investor-Owned Utilities (IOUs), and with other DR research organizations, national laboratories, trade allies, and state agencies, to leverage other sources of funding. The EM&T program has successfully collaborated on research funded from the California Energy Commission's (CEC) Electric Program Investment Charge (EPIC) program through their Grant Funding Opportunities (GFOs), the Electric Power Research Institute (EPRI), Lawrence Berkeley National Laboratory (LBNL) and other research organizations.

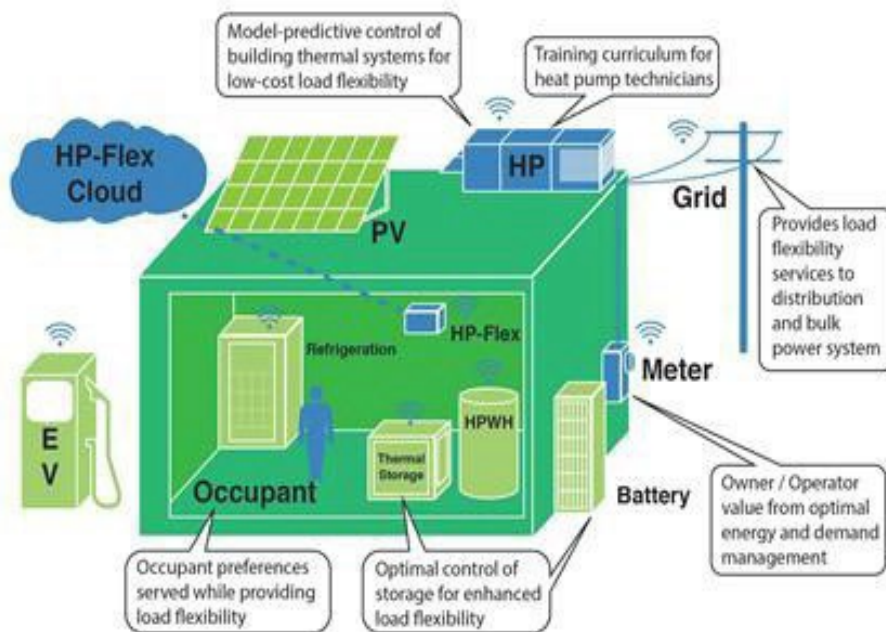
The Customer Solutions (CS) organization at SCE oversees the EM&T program's activities, and the program is funded through the CPUC's four-year (2024 – 2027) approved authorization from (D.) 23-12-005, dated December 14, 2023. In accordance with the CPUC direction for the reporting of the DR EM&T program, this report covers SCE DR EM&T program activities during the period between January 1, 2026, and June 30, 2026, for Q1 – Q2 of program year 2026.

2. Projects Continued Q1 – Q2 2026

DR22.02 HP-Flex: Next Generation Heat Pump Load Flexibility DR (GFO-19-301)

Overview

Lawrence Berkeley National Laboratory (LBNL) submitted a proposal to the CEC in response to Electric Program Investment Charge (EPIC) solicitation GFO-19-301, Group 4. The proposal was awarded a contract agreement (EPC-19-013) by the CEC to fund the development and field site evaluation of an open-source, scalable, low-cost control flexible heat pump solution (HP-Flex) for optimal demand management of high-efficiency heat pumps in small and medium commercial buildings. SCE provided a Letter of Commitment (LOC) in support of LBNL's proposal and is providing a cost share from the EM&T program.



HP-Flex: Next Generation Heat Pump Load Flexibility

The goal of the project is to develop open-source control algorithms and educational curricula to train the next generation of engineers and technicians, to help promote the large-scale deployment of replicable, demand-flexible heat pump installations in small to medium-sized commercial buildings, and to increase benefits to both individual building owners and the distribution grid by enhancing heat pump demand flexibility. This new system will minimize energy use while allowing buildings to effectively participate in flexible DR programs and dynamic pricing tariffs, to provide reliable and cost-effective load flexibility to the grid.

The project objectives are:

- Develop an advanced, integrated, open-source control system to cost-effectively provide energy optimization and load flexibility to heat pumps in small and medium commercial buildings.
- Verify that flexible heat pumps can meet the following criteria:
 - 1) Achieve a 20% reduction in site peak energy costs compared to a traditional heat pump with scheduled thermostatic control.
 - 2) Provide 50% load shed during summer or winter peak-load events.
 - 3) Provide 20 kWh of daily load shift capacity for a typical commercial building during the shoulder seasons.
 - 4) Provide demand flexibility services equivalent to 10% continuous response of average baseline load.
 - 5) Enable 25% of the baseline load to respond to dynamic prices to shape daily load profile in summer and winter.
 - 6) Meet a financial payback period of 2 years.
- Integrate and control a thermal energy storage system with a heat pump optimized with HP-Flex.
- Develop educational curricula to train engineers and technicians on the design, installation, and maintenance of load-flexible heat pump systems.

The project was co-funded under the EM&T Market Assessments and Technology Assessments investment categories, as there are elements of both research goals in this study. The Market Assessments category is designed to create a better understanding of the emerging innovation and developments of new consumer markets for DR-enabling technologies and an awareness of consumer trends for smart devices. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities.

Collaboration

SCE is working with LBNL as a co-funding partner and active reviewer of the work in progress. SCE engages other industry stakeholders and subject matter experts that serve on the Technical Advisory Committee (TAC) establishing direction for the research team and to ensure that SCE is receiving the learnings from the project that are most valuable to its customers.

Results/Status

A project coordination meeting was held early in Q2 2026, during which preliminary findings and project status updates were presented to SCE stakeholders. Discussions focused on progress to date, initial observations from the field deployments, and the path toward final analysis and reporting. Throughout the two quarters, the LBNL team worked through deployment delays affecting the final two field test sites while maintaining active monitoring and data collection across operational sites.

To maximize the value of the dataset, data collection activities extended through the end of Q2 2026, allowing the project team to capture additional seasonal operating conditions and performance variability. This expanded dataset is expected to strengthen the final analysis by providing a more representative view of system performance across differing weather conditions, customer behaviors, and operational scenarios. Concurrently, LBNL continued data processing and analysis activities to commence final report development documenting the HP-FLEX findings and recommendations.

Next Steps

LBNL and SCE will continue to coordinate on preparing the final report, with submission to the California Energy Commission (CEC) planned for Q3 2026. LBNL and SCE will finalize the technical review, stakeholder feedback, and closeout activities to ensure the final report accurately reflects project outcomes and lessons learned. The project remains on track for completion in Q4 2026, at which time the finalized report and key findings will be distributed to the appropriate stakeholders and used to inform future program and technology deployment efforts.

DR23.01 DR-TTC Dynamic HVAC Test Chamber

Overview



SCE Technology Test Center (TTC)

SCE's Technology Test Center (TTC) evaluates a variety of technologies in controlled environments that mirror real-world conditions and customer experiences. This generates comprehensive performance data and innovative test methods which are used by SCE customers, policymakers, and utility programs to make informed decisions regarding the investment and application of cleaner technologies. The TTC is pursuing a major renovation project to the facility layout and is pursuing updates to its testing capabilities.

Dynamic testing or load-based testing is necessary to better characterize the performance of the actual advanced controls of these heat pump systems. Current TTC HVAC lab test capabilities are limited to steady state methods that disable native HVAC controls. A dynamic test method in the lab produces metrics/results that include the operation of native controls. It is important to assess test methods that can provide ratings representative of field performance when equipment is operated under its own controls and under loads that vary with ambient temperature. Additionally, the test chamber could also be used to test other small commercial self-contained refrigeration equipment.

Project objectives are:

- Construct an environmental test chamber capable of advanced dynamic HVAC testing.
- Demonstrate a dynamic test and generate sample test data.
- Identify and prioritize near-term potential test projects, which may include but is not limited to the Advanced Heat Pump Coalition's Heat Pump Rating

Representativeness Validation Project, LBNL CEC projects to supplement laboratory testing, F-Gas Reduction Incentive Program (FRIP), and parallel EPRI laboratory testing.

The project is co-funded under the EM&T Technology Assessments and Technology Transfer investment categories, as there are elements of both research goals in this study. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities. The Technology Transfer category advances DR-enabling technologies to the next step in the adoption process by raising awareness, developing capabilities, and informing stakeholders in initial stages of emerging technology development for potential DR program and product offerings.

Collaboration

The project is being co-funded by the SCE Technology Test Centers, the SCE Emerging Technologies program, and the SCE Codes and Standards program. The completion of this test chamber will enable a wide variety of future project partnerships to support programs/activities such as the California Statewide Electric Emerging Technologies Program, Building Electrification, Codes and Standards, CEC EPIC, CARB - FRIP, and CalFlexHub.

Results/Status

During Q1 and Q2 2026, the Technology Test Center team continued coordinating with its laboratory chamber contractor and internal facilities organizations to advance the renovation and readiness of the test facility. Efforts focused on planning and executing the activities necessary to prepare the laboratory chambers for future testing, including equipment procurement, installation planning, commissioning preparation, and project scheduling.

The team also worked through several facilities related requirements needed to support the upgrades. This included obtaining and coordinating required permits, evaluating and implementing electrical infrastructure improvements, and addressing structural modifications necessary to accommodate new equipment and ensure compliance with site requirements.

Next Steps

The team will continue activities through Q3 — Q4 2026, where necessary permitting is the next milestone expected for completion during that period. The overall test chamber is targeted for completion by end of Q2 in 2027.

DR24.01 Behind the Meter Optimization of Load Technologies (BOLT) Study

Overview

The Emerging Markets and Technology (EM&T) program examines emerging markets and assesses technology advancements to develop a forward-thinking approach to cost-effectively revolutionize SCE's future DR customer programs. In 2025, the EM&T program developed the Behind the Meter Optimization of Load Technologies (BOLT) study to explore innovative DR system approaches to capture a wide range of residential consumer technologies, such as emerging smart-home end uses and appliances, to significantly enhance both customer benefits and grid performance.

This strategic assessment study is investigating emerging consumer technologies that have load management capabilities, including electric vehicles (EVs), behind-the-meter (BTM) batteries, and other potentially flexible, dispatchable appliances and systems. The BOLT study is also designing and testing new incentive models that are specifically crafted to boost customer participation and performance of these advanced technologies in new models of demand response. By also conducting a field assessment of these cutting-edge technologies alongside attractive incentives, the BOLT study intends to demonstrate the efficacy of load management measures utilizing an innovative comprehensive operational model structured to manage a diverse load management end use portfolio.

Research questions for the study include the following:

Primary Design Issues:

- What are the demand reductions (for development of deemed savings) that can be delivered by various end uses, individually and as a bundle?
- What are the reductions per SCE customer and per device under different scenarios/planning conditions?
- How do the magnitude and duration of dispatchable demand vary as a function of controllable end uses, weather conditions, event start, and hours into the event?
- How do incentive levels, modes of communication, and intensity and channel of marketing influence participation rates?
- What end uses and devices are most cost-effective for participation?

Secondary Operational Factors:

- How many sites should SCE enroll in BOLT to ensure it can accurately estimate load impacts?
- What are the identifying characteristics of customers who enroll in BOLT?
- What is the current saturation and geographic location in SCE territory for specific types of connected devices applicable for BOLT?

- How large (connected kW) are the end use loads, and how coincident are their annualized load shapes with SCE and CAISO peak loads?
- What communication protocols are used by the connectable devices, and are they compatible with receiving DR signals and dispatches?

A key research objective for the BOLT study is to investigate how SCE can enhance customers' experience through a unified program tariff for multiple load management technologies at one service location. This new model has the potential for simplifying the enrollment process, providing customers with a seamless experience and clear insights into potential earnings from their participation in load management programs. It will allow customers to enroll multiple load management technologies under a single program, replacing the current system where different technologies require separate enrollment processes. This streamlined approach is poised to transform how customers interact with load management programs, making it easier and more rewarding to participate in reliability programs and demand flexibility.

The project is funded under the EM&T Market Assessments and Technology Assessments investment categories, as there are elements of both research goals in this study. The Market Assessments category is designed to create a better understanding of the emerging innovation and developments of new consumer markets for load management-enabling technologies and an awareness of consumer trends for smart devices. The Technology Assessments category assesses and reviews the performance of load management-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities.

Collaboration

To implement the study, SCE will be working with internal teams and an external consultant to develop the study design, operations, M&V, and go-to-market strategy. The first phase of the study will be to conduct residential customer surveys to assess the range of customer interest in different incentive structures, options for dispatch timing and durations, and availability of in-home technologies.

In addition, there are other technology and software providers who already manage groups of SCE customers for demand management services and other value streams. These aggregators and third-party technology owners (TPOs) will be engaged to collaborate with SCE in assessing the technologies as they are integrated in the field.

SCE is continuing to engage other innovative partners interested in collaborating with the study. SCE expects that these partners can provide consulting and technical services in the areas of market and grid operations, licenses for automated service platforms, economic reviews, and system impact analyses (e.g. avoided cost calculations), and the estimation of load shift impacts and energy reduction savings.

Results/Status

During Q1 – Q2 2026, the BOLT study completed its Phase 1 activities that were conducted during the summer and winter of 2025. That initial effort made substantive progress toward a scalable multi-DER demand flexibility framework centered on daily load shaping, incremental event-based dispatch, and a simplified customer experience across batteries, EVs, and smart thermostats. Demonstrated portfolio growth at the end of the year, dispatch analytics, and operational buildout collectively reinforced the study's "battery-first" renewed design approach while continuing to test the complementary roles of EVs and thermostats.

In addition, BOLTs 1.0 successfully demonstrated the growing potential of customer-owned energy technologies to support grid reliability while delivering value to participants. The study provided important insights into successful customer engagement, adaptive program design, real-world technology performance, and the industry partnerships that were interested in helping advance the understanding of how distributed energy resources can contribute to a more flexible, resilient, and customer-centered electric grid. The lessons learned established a strong foundation for the future development of a successor study to investigate virtual power plants and grid-integrated energy management solutions. In meeting its research objectives, the BOLTs 1.0 study:

1. Demonstrated the growing role of customer-owned energy resources in supporting the grid

BOLTs 1.0 showed how technologies such as batteries, electric vehicles, and smart thermostats can be aggregated and coordinated to provide value beyond the individual customer, helping illustrate the future potential of customer participation in grid operations.

2. Advanced virtual power plant innovation across multiple technologies

Unlike traditional demand response programs that often focus on a single enabling technology, BOLTs 1.0 explored how multiple distributed energy resources can work together within a unified framework, helping inform the evolution of next-generation virtual power plants.

3. Generated valuable insights into customer participation and engagement

The study improved the overall understanding of how customers interact with energy flexibility programs, including preferences around participation, communications, incentives, and automation. These insights can help shape future customer-centric demand response programs.

4. Strengthened industry collaboration and market readiness

The collaborative design of the BOLTs study brought together technology providers, device manufacturers, and energy management platforms as a

project team, creating a better understanding on how the distributed energy ecosystem can work together at scale for a future DR program.

5. Established a foundation for future grid flexibility solutions

Perhaps the most important outcome of the BOLTS 1.0 activity was the creation of a knowledge base of real-world learnings and customer performance metrics that can inform future pilots, programs, and market structures that can be designed to leverage distributed energy resources in support of reliability, affordability, and customer choice.

Next Steps

Planning for future work is in progress. In early 2026, the study developed its BOLTS Phase 2 (BOLTS 2.0) approach and identified the cohort of vendors to place under contract for the next round of dispatch events to meet the research needs of the study. In early Q3, the team will then conduct notch testing and communications verification and begin the next round of enrollments. This Phase 2 project plans to test the ability to develop a cost-effective flexible load program that allows for easy onboarding of new technologies (e.g. batteries, EVs, thermostats) for Demand Response/Flexibility among residential customers. The study will continue to recruit customers with multiple controllable devices through asynchronous enrollments (batteries first, supplemented by other technologies), seamlessly integrate them into program dispatch, and incentivize them for the grid value they produce.

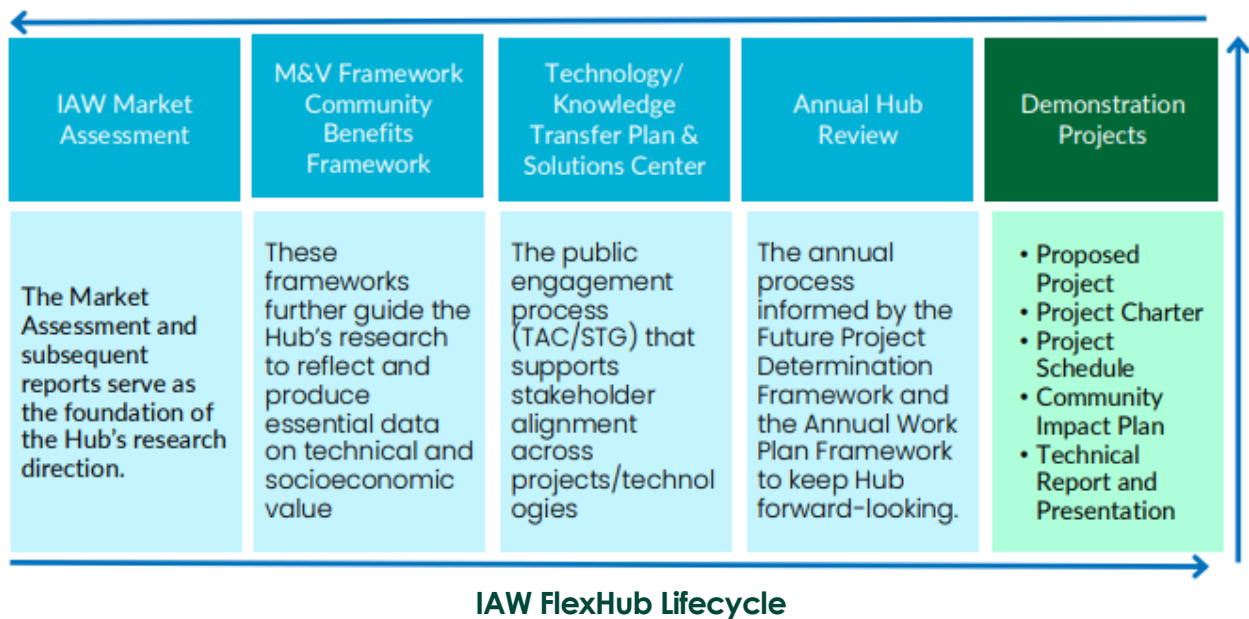
The BOLTS 2.0 study will subsequently explore whether customer-owned batteries, EVs, and smart thermostats can be orchestrated to function as a flexible grid resource capable of supporting both local distribution and broader system needs. Unlike traditional demand response programs that primarily focus on event-driven load reduction, BOLTS 2.0 will test daily demand flexibility strategies, coordinated DER management, and targeted dispatch. The study's findings seek to provide valuable insights for the design of next-generation load flexibility and virtual power plant programs.

DR25.03 EPRI IAW FlexHub SPA (GFO-23-316)

Overview

SCE is partnering with the Electric Power Research Institute (EPRI) to support the California Energy Commission’s (CEC) Industrial, Agricultural, and Water (IAW) (FlexHub), a CEC initiative funded under Grant Funding Opportunity GFO-23-316. The FlexHub program, administered by Momentum, will convene leading research organizations, including EPRI, UC Davis, LBNL, Stanford University, Fresno State, and others, to advance pre-commercial demand flexibility (DF) solutions for California’s industrial, agricultural, and water (IAW) sectors.

California’s IAW sectors represent some of the largest and most energy intensive energy loads in the state, yet adoption of demand flexibility technologies has historically lagged due to high implementation costs, limited operational research, and a lack of sector-tailored energy controls. The FlexHub aims to address these gaps by demonstrating scalable, cyber-secure DF technologies that can shift, shed, shape, or shimmy load in real-time response to price, grid, or emissions signals.



SCE is participating as both a research collaborator and cost-share partner, committed to supporting and conducting field demonstrations within SCE territory. The partnership directly supports statewide and utility-specific objectives for statewide flexible load integration, including California’s statutory goal to achieve 7,000 MW of load shift by 2030.

The project is co-funded under the EM&T Technology Assessments and Technology Transfer investment categories, as there are elements of both research goals in this study. The Technology Assessments category assesses and reviews the performance

of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities. The Technology Transfer category advances DR-enabling technologies to the next step in the adoption process by raising awareness, developing capabilities, and informing stakeholders in initial stages of emerging technology development for potential DR program and product offerings.

Collaboration

EPRI will lead several large-scale demonstration efforts within the FlexHub, focusing on developing and validating DF enabling technologies across multiple IAW subsectors, such as wastewater facilities, food processing and cold storage, industrial manufacturing processes, and agricultural farming and irrigation pumping operations.

SCE will collaborate closely with EPRI and Momentum in the following areas:

- Identifying IAW customer sites within SCE territory suitable for initial demonstrations
- Developing a transparent Future Demonstration Project Determination Framework to guide annual project selection
- Providing load metering and operational data, where permissible, to support load shape analyses and DF potential modeling
- Participating in stakeholder working groups, including local community, industry, and manufacturer stakeholder groups
- Reviewing project scoping, installation plans, evaluation frameworks, and reporting deliverables
- Ensuring alignment with SCE's load management priorities, including resilience, affordability, and customer equity

This collaboration leverages EPRI's technical expertise and SCE's customer relationships to accelerate adoption of cost-effective DF solutions across high-load industrial, agricultural harvest systems and pumping, and water-related processing operations.

Results/Status

The first half of 2026 focused on launching and expanding the overall California IAW FlexHub outreach activities while maintaining strong coordination across project teams and stakeholders. The IAW FlexHub Launch Event was held at the UC Davis Industrial Decarbonization and Materials Symposium, and regular All Teams Meetings coordinated open call activities, stakeholder engagement, task progress,

outreach efforts, and CEC feedback. To strengthen stakeholder engagement, Momentum developed a shared resource for tracking stakeholder group membership and expansion efforts, helping the leads coordinate outreach activities and identify opportunities to broaden participation through professional networks, industry events, and website sign-ups. The IAW Hub's first Open Call, launched on March 16 and closed on June 19, generated strong statewide participation, receiving 16 concept submissions representing six industrial subsectors and all California IOU service territories. Momentum initiated the concept review process and prepared to share findings with the CEC in July.

A major milestone during the two quarters was the CEC's first Critical Project Review (CPR) in late April, which resulted in a positive determination to continue project funding along with a set of follow-up actions for the Hub team. The Momentum team advanced several action items, including updating the website and open call materials to better connect applicants with research partners, supporting stakeholder outreach, coordinating with CAM on open call promotion, and continuing discussions with the CEC regarding anticipated cost shifts and project needs. Across project tasks, the team completed the M&V Plan outline, continued development of data management and analytics infrastructure, advanced literature reviews, reviewed Customer Implementation Plans, and progressed several demonstrations through planning, M&V, charter, budget amendment, and technical review activities.

Next Steps

In the latter half of 2026, the project team will advance detailed technical design, customer engagement, and demonstration planning for each of the sub-projects. Key activities include:

- Continued operation of the Annual Technology Portfolio and Work Plan, including detailed scopes for SCE-territory demonstrations
- Compiling feedback from stakeholder engagement groups and delivering Community Impact Report #2 and results in a Year 1 M&V Memo
- Coordination with SCE on site permitting, data access procedures, and customer readiness assessments for approved projects
- Supporting Momentum in developing Year 1 – 5 Future Research Recommendations that align statewide priorities with SCE's needs

Demonstration deployments are to begin in Q3, with technology installation, commissioning, and early operational data collection expected shortly thereafter.

DR25.04 EPRI LAUSD-FLEX SPA (GFO-23-309)

Overview

The LAUSD-FLEX project is designed to demonstrate, at a school-district scale, the capability of interoperable energy management systems (EMS) delivering repeatable, standards-based demand flexibility across large commercial campuses, without locking facilities into proprietary EMS platforms. By focusing on interoperability and open standards (e.g., BACnet 135 for building systems; OpenADR 2.0B and IEEE 2030.5 for automated signaling), the demonstration aims to create a replicable template that other public-sector portfolios can adopt. The effort is funded under the CEC's VPP-FLEX (GFO-23-309) Group 2 and managed by EPRI to address the market's current fragmentation and to show how a common, standards-aligned approach can broaden participation in utility demand flexibility.

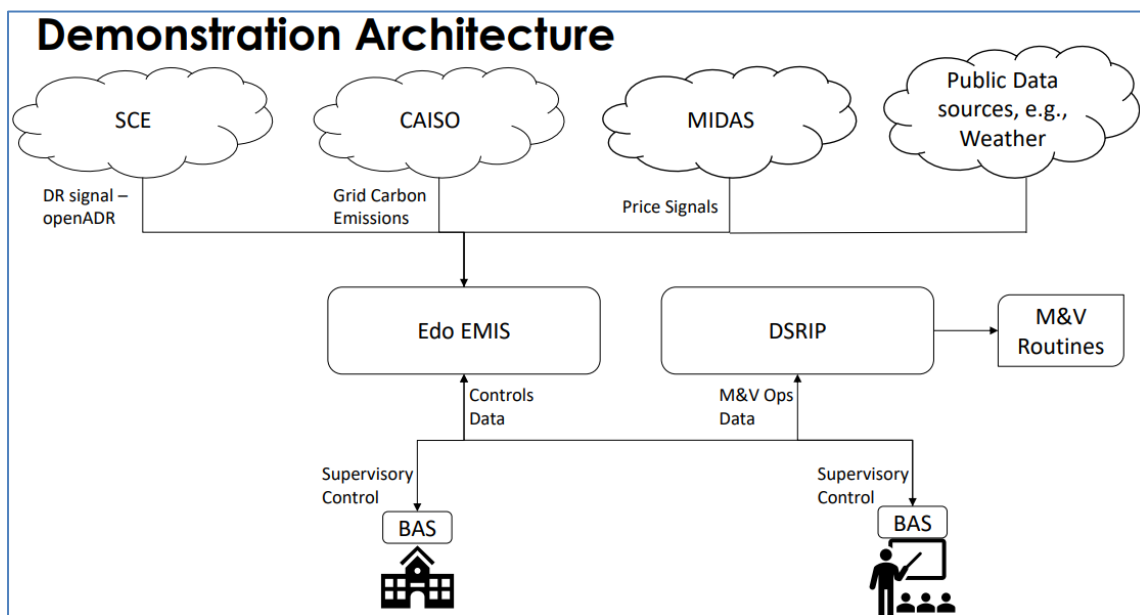
At its core, the project will evaluate whether an interoperable EMS can coordinate major controllable end uses in schools (HVAC, lighting, and EV charging) to meet programmatic performance thresholds ($\geq 10\%$ summer peak-hour reduction; $\geq 5\%$ winter peak-hour reduction) while staying within operational constraints and preserving occupant comfort. The solicitation also requires mature technologies and enrollment in an IOU demand response program by project completion, ensuring the work translates into real, grid-connected operations rather than being limited to pilots. This makes LAUSD-FLEX as much a market enablement project as it is a technology integration one.



Maywood Center for Enriched Studies

Large school facilities consist of significant, schedulable loads with predictable occupancy patterns, increasingly paired with on-site PV and EV charging. Orchestrating these resources via an interoperable EMS provides a scalable pathway to load shaping, shifting, and shedding, and to carbon-aware operation, without bespoke integrations at every site. The project’s focus on standards-based signaling and open interfaces is intended to catalyze district-wide and, ultimately, statewide replication, while offering a realistic playbook for program enrollment, tariff alignment, and coordination with utility platforms.

From a ratepayer and equity perspective, the project is also structured to deliver benefits in disadvantaged communities and low-income communities (DAC/LIC). Beyond near-term bill management and peak demand relief, the demonstration is expected to identify cost-to-benefit drivers, highlight adoption barriers (technical and business-model), and document best practices for interoperable EMS deployment in the public-sector building context. Those insights will support broader policy and market developments including future price-responsive tariffs, carbon-aware dispatch, and potential alignment with emerging building performance policies cited in the project objectives.



LAUSD Project Demonstration Architecture

Finally, LAUSD-FLEX is intentionally positioned as a bridge-to-scale effort: it tests utility-compatible automation (standards-based communications, utility DR enrollment) while codifying integration and operational patterns that facilities teams and solution providers can re-use across portfolios. By centering on interoperability and repeatability, the project seeks to de-risk district deployments and accelerate commercial pathways for EMS-based demand flexibility in California’s education sector and beyond.

The project is co-funded under the EM&T Technology Assessments and Technology Transfer investment categories, as there are elements of both research goals in this study. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities. The Technology Transfer category advances DR-enabling technologies to the next step in the adoption process by raising awareness, developing capabilities, and informing stakeholders in initial stages of emerging technology development for potential DR program and product offerings.

Collaboration

EPRI serves as prime for the CEC EPIC contract and leads the project design, coordination, and tech transfer; Edo provides the enterprise DERMS/EMIS integration layer; Kliwer & Associates leads M&V and data analysis; New Buildings Institute (NBI) supports technology transfer; LAUSD provides sites and facility access; Brotherhood Crusade engages as a community-based organization; and SCE supports program alignment and site enrollment in DR/Auto-DR, data interfaces, and overall utility coordination under the EM&T program.

The demonstration architecture integrates SCE's DR signaling (OpenADR) and price/carbon data from the CEC and others (e.g., MIDAS, CAISO marginal emissions) with a grid-edge DERMS, which supervises building-level EMS/BAS to actuate HVAC, lighting, PV-adjacent operations, and EVSE in response to DR, pricing, and emissions objectives. EPRI functions as the data aggregator and system of record for M&V, with routines to evaluate control efficacy and measured load impacts.

Results/Status

During Q1 – Q2 2026, the project progressed on initial execution of technology installations and integration readiness, including:

- Tech Transfer and TAC: Successfully convened TAC #1 meeting with strong participation; incorporated stakeholder feedback on cost-effectiveness and payback into project approach.
- Design & site integration development: EPRI and Edo documented site conditions and defined technical requirements for EMS/BAS, lighting and gateway integration.
- Technology Installation Planning and Deployment: In Q1 2026, EPRI and Edo completed technology installation memo outlining procurement, installation approach, and deployment schedule. Phase 1 technology installation of the Edo Gateway was completed in Q2 2026, with Phase 2 installations currently underway.

- Demand flexibility strategy: SCE confirmed that both LAUSD test sites are enrolled and will participate in SCE's Emergency Load Reduction Program (ELRP) as part of the demand flexibility strategy. SCE registered Edo and LAUSD stakeholders for event notification updates. EPRI and Edo delivered a fully developed, site-specific strategy prioritizing ELRP-based load reduction with additional research signals integrated, including dynamic pricing research.
- EV integration readiness: EPRI developed a second EVSE utilization survey to inform the design of the EMIS-controlled EV charging integration and initiated site engagement.
- Workforce & community: EPRI finalized workforce training and community engagement plan with partners.
- Site access & M&V Planning: EPRI and Edo executed site access agreements and clearances with LAUSD. EPRI and Edo completed M&V Test Plan and baseline system installation at both sites with all monitoring systems installed and operational with validated data transfer. M&V baseline on major electrical loads at both sites is underway, with automation scripts to import the data periodically to the EPRI database currently operational.

Next Steps

The project will endeavor with the following activities for the next few months:

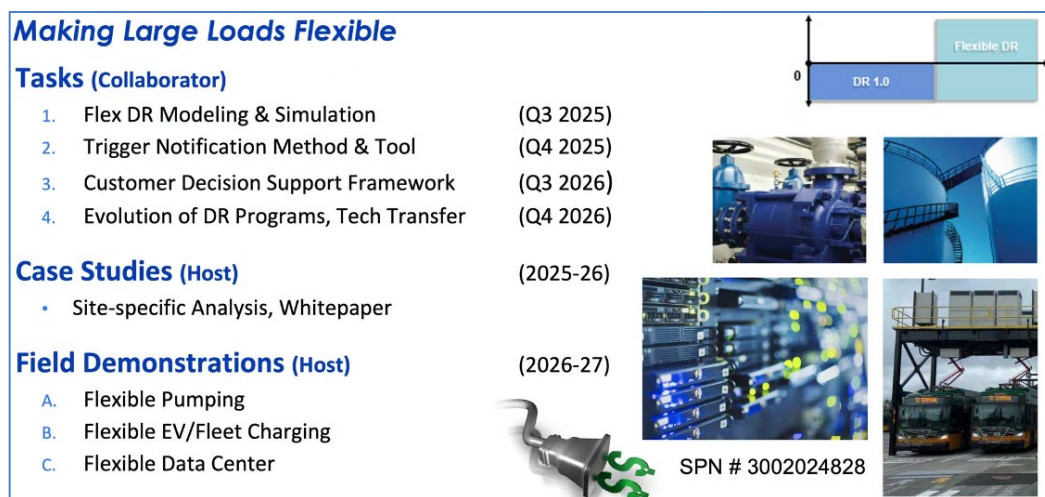
- Technology installation: Complete Phase 2 technology installation & commissioning at selected sites, including charging lighting control upgrades, HVAC control upgrade, EV charging integration, and thermostat deployment.
- EV integration: finalize EVSE pilot control plan with LAUSD site for EMIS/DERMS orchestration.
- Workforce Development: finalize workforce training materials and student engagement activities for Fall 2026 training events.
- Progress Presentation: prepare for mid-point presentation following full technology deployment at both sites.

DR25.06 EPRI FLEX DR 2.0 SPA

Overview

SCE is participating in EPRI's Flexible Demand Response (Phase 2) Collaborative to develop, validate, and operationalize flexible demand response (Flex DR) as a dependable grid resource — explicitly encompassing both "Power Down" (load reduction) and "Power Up" (beneficial load increase during surplus renewable generation). The initiative was originally focused on large water pumping loads, including well extraction, booster, influent/effluent, and filtration pumps, which typically range from ~100 kW up to 1 MW.

Phase 2 of the EPRI collaborative is structured to demonstrate Flex DR capability and value at scale with much larger loads, and to define how Flex DR should be represented in system planning and grid operations. Beyond proving technical feasibility, the work targets programmatic and operational challenges that have historically limited customer participation in demand flexibility, namely uncertainty in response characteristics and persistence over time. The scope embraces a two-sided flexibility paradigm in which large loads respond not only to peak-reduction needs but also to absorb clean energy when renewable energy is being curtailed, enabling balancing during steep ramps and unlocking new customer cost-management strategies with the availability of lower energy prices.



Flex DR Collaborative Phase Two Overview

To achieve this, the collaborative combines analytical development with field-proximate activities. First, EPRI extends Flex DR models and simulations originally developed in Phase 1, refining resource attributes so they can be scheduled and dispatched with confidence in production-cost, resource-adequacy, and market-operations contexts. Second, site-specific case studies evaluate Flex DR strategies at candidate pumping facilities and prototype an operator

decision-support concept that translates grid requests into actionable plant-level operating modes. Third, the demonstrations progress Flex DR from analysis to practice, aligning test plans to system flexibility requirements and documenting realized value streams and operational learnings. Taken together, these tracks create a pipeline from model → tooling & procedures → demonstrated operations.

The modeling outputs emphasize parameters essential to grid use of flexible loads: minimum/maximum power levels, ramp rates, response times, event duration, near-term predictability, and long-term persistence. These attributes are being calibrated to real-world operations and translated into modeling formats recognized by planners and operators, so Flex DR from large pumps can be co-optimized alongside supply-side resources. The anticipated system benefits include reduced renewable curtailment, improved capability to follow variable output ramps, lowered emissions, and customer cost savings, all anchored in standardized model forms that can be reused across utilities.

A key innovation in Phase 2 is the Trigger Tool demonstration, designed to provide automated, advance notifications of Flex DR events to customers based on both grid needs and customer-expressed operating preferences. The tool ingests market and public data, such as anticipated negative prices, weather conditions, or marginal emissions indicators, to forecast Flex DR opportunities within operator-relevant timeframes. Publishing the requirements and data-processing approach demystifies how signals are sourced and translated, lowering the barrier for utilities and site operators to adopt repeatable, automated pre-event workflows.

In parallel, the Collaborative is developing a Customer Decision Support Framework that abstracts common operating considerations for water and wastewater plants into a generalized operator interface. The framework presents the capability and limits of plant systems for Power Down and Power Up participation, links those to program/rate constructs, and supports safe, repeatable responses that respect process constraints, water-quality requirements, and service levels. By codifying these decision patterns across different program designs and regional grid conditions, the framework aims to make Flex DR scalable and portable across agencies and utility territories.

Finally, while large water service pumps are the primary focus of the collaborative the assessment, the collaborative framework is extensible to other large, schedulable loads including electric bus depots and data centers, where Flex DR can be shaped around predictable operating windows and storage-like flexibility. This broadens the pathway for utilities to source customer-side flexibility that complements traditional DR and supply-side resources, supporting an affordable, cleaner, and more reliable grid.

The project was funded under the EM&T Market Assessments and Technology Assessments investment categories, as there are elements of both research goals in this study. The Market Assessments category is designed to create a better understanding of the emerging innovation and developments of new consumer markets for DR-enabling technologies and an awareness of consumer trends for smart devices. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities.

Collaboration

EPRI leads project design, analytics, coordination, and knowledge transfer; EPRI electric utility member funders (including SCE) participate in quarterly collaborative meetings, help prioritize use cases, and provide program information and potential host-site introductions. The joint collaborative scope covers Flex DR model and simulation, a Trigger Tool demonstration to deliver advance, automated event notifications aligned with grid needs and customer preferences, and a Customer Decision Support Framework that distills common requirements for plant operators (e.g., water agencies) to safely and repeatedly participate in Power Down/Power Up events within operational limits. Deliverables will be shared with SCE water customers in an accelerated technology-transfer approach intended to support rapid adoption across utilities and large-load customers.

Results/Status

During the first half of 2026, the research team advanced its assessment of data center demand flexibility from initial market characterization toward the development of actionable flex strategies and field demonstrations. The project completed analysis of data center load profiles and published a technical brief summarizing observed operating patterns and opportunities to manage rapidly growing data center demand.

Building on this analysis, the project identified several priority research needs, including evaluating the ability to curtail and interrupt information technology loads by application type, examining customer engagement models capable of inducing demand flexibility, reviewing existing utility programs serving data centers, and identifying gaps that could be addressed through pilot demonstrations. Potential engagement models considered included alternative pricing, paid-for-performance structures, public cooperation approaches, and variable service subscriptions that would allow data centers to select service attributes based on their operational requirements.

The initial research also produced a clearer technical and market framework for developing strategies for flexing data center loads. Enterprise data centers were

identified as particularly suitable demonstration candidates because they typically control their own IT equipment, unlike colocation facilities where equipment and workloads may be controlled by multiple tenants. The project further identified the need to bridge the organizational divide between facilities and energy personnel, who focus on demand management, and IT personnel, who prioritize uptime, availability, and response time. These findings support incorporating flex-readiness requirements into new data center development and interconnection processes rather than attempting to retrofit flexibility after systems are operational.

The proposed operational strategy for demonstrating flexibility in data centers includes both Flex Down and Flex Up capabilities. Flex Down would slow or throttle selected generative AI jobs within acceptable user-performance limits, while Flex Up would increase the number or processing rate of jobs when grid capacity or favorable operating conditions are available. Collaborative polling of the EPRI stakeholder team advisors showed strong support for demonstrating these strategies, with 60 percent of respondents fully supporting the proposed approach. Advisors ranked hyperscale and enterprise data centers as the preferred long-term demonstration environments, while also recognizing the value of beginning with a smaller server-room installation where GPU power management and user impacts can be evaluated under controlled conditions.

Next Steps

In the second part of 2026, the EPRI team will move the project from strategy development into host recruitment, case-study execution, and demonstration planning, alongside a shift in staff leadership. The team will pursue participation from utilities and a proposed Silicon Valley startup operating three GPU servers for generative AI sound and image production in a small server room. Following host authorization, the initial three-month case study will collect and analyze interval meter data, identify historical GPU-throttling events, quantify associated power savings, and interview the operator to document operating limitations, differences between Flex Down and Flex Up strategies, user impacts, and applicable market segments. In parallel, the team will pursue a hosted demonstration at a similar site, including the installation of panel- or outlet-level instrumentation, selection of day-ahead or day-of event triggers, comparison of measured power impacts with theoretical expectations, and surveys to establish acceptable performance boundaries and the potential for user attrition.

DR25.07 EPRI Smart Panel Field Study

Overview

A “smart” electrical panel is an advanced version of the standard household electrical panel for providing electrical service protection for circuit distribution to a home, with the main difference being that the “smart” panel has the capability to measure and control electricity usage. There are three types of smart panels: 1) main panel replacement; 2) supplemental load panel to house, monitor, and control critical loads only; and 3) traditional load panel with smart circuit breakers.

Smart electrical panels offer a potential alternative to costly service upgrades at houses with retrofits, DERs, and all-electric appliances by actively managing end use loads and on-site distributed energy resources (DERs) such as electric vehicle charging, batteries, and heat pump water heaters. When circuit loads approach the maximum service capacity, the panel can automatically prioritize or shed specific circuits to prevent exceeding service limits. This can defer or avoid costly service upgrades while enabling the installation and efficient use of new electric appliances.



Growing Landscape of Smart Panel Products

Beyond load control, these panels provide granular telemetry that can help residents better understand and optimize their electricity use. By networking multiple smart panels across SCE’s service territory, they could form part of a broader demand-side management portfolio, supporting dynamic demand management and grid-edge operations. The technology may also open new pathways for customer engagement, allowing easier integration of DERs, and enabling participation in demand response programs by integrating with utility local

grid control systems across diverse end-uses.

The Smart Panel Field Study ("Study") is designed to test and evaluate the capabilities of advanced circuit-level load management technology in residential settings, focusing on homes participating in SCE's Low Income Building Electrification (BE) pilot and the Energy Coalition's Bassett-Avocado Advanced Energy Community (BAAEC) initiative. The Study is part of an overall strategy to evaluate opportunities for residential "grid edge" technologies to enable and support the impending increase in electric transportation and other electric loads, in tandem with the local electric distribution system and future models of demand flexibility and dynamic pricing.

The Study will deploy in its first phase up to 18 smart panels of various designs in homes with existing or planned electric appliances and/or DERs. Each installation will be tailored based on a detailed review of site characteristics, existing panels, breaker configurations, and load mapping. EPRI, serving as technical advisor and project manager, will guide smart panel selection, coordinate with original equipment manufacturers (OEMs), and support local permitting approvals. Circuit-level monitors will be installed at each site for at least one year to track energy consumption and peak load contributions by end use. The study will analyze these data to quantify demand flexibility potential, evaluate load-limiting performance, assess demand response integration opportunities, and develop strategies for customer engagement and future program design.

The project was funded under the EM&T Market Assessments and Technology Assessments investment categories, as there are elements of both research goals in this study. The Market Assessments category is designed to create a better understanding of the emerging innovation and developments of new consumer markets for DR-enabling technologies and an awareness of consumer trends for smart devices. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities.

Collaboration

EPRI is leading the technical advisory and project management activities, working closely with SCE's Low Income Building Electrification team and the Energy Coalition. SCE will identify candidate homes, provide site access and AMI data, and handle procurement, permitting, and installation of the panels. EPRI will recommend appropriate smart panel models for each site, coordinate with OEMs, support permitting, and facilitate installer training. Additional collaboration includes integrating circuit-level monitoring, developing data collection infrastructure, and aligning the project with broader demand-side management strategies. As part of the market assessment, EPRI will also provide a tech assessment of any new

products that become available during the current Study.

Results/Status

During the first half of 2026, the team made meaningful progress toward expanding the deployment and evaluation of smart panel technologies despite programmatic and permitting challenges. The project team continued advancing installations through both the Haven Energy and SCE Building Electrification (BE) candidate pipelines while initiating preliminary analysis of operational data from completed installations.

Within the Haven Energy cohort, three of the nine candidate sites completed smart panel installations. An additional four sites received permit approvals and entered installation scheduling. The remaining two sites experienced permitting delays related to the integrated solar and battery components of the projects rather than the smart panels themselves. Progress within the Haven pipeline was initially affected by a statewide pause in Self-Generation Incentive Program (SGIP) funding, which impacted eight of the nine sites. Because Haven's solar and battery installations are funded through SGIP and are often paired with smart panel upgrades, project activity slowed until SGIP funding restrictions were lifted in late April.



Customer Site Installation and Smart Panel Selection

Following the release of the funding hold, project activity resumed, although several sites continued to experience delays associated with solar and battery system design,

permitting, inspections, and utility approvals. For example, one site faced extended permitting due to concerns regarding roof integrity for solar installation, while another experienced delays obtaining SCE meter-spot approval. The SCE BE pipeline also advanced three candidate sites to complete install status and an additional three sites entered permitting and installation scheduling.

To support knowledge sharing and stakeholder engagement, the project team hosted a mid-point webcast in May that was open to relevant SCE groups. The presentation summarized installation progress, lessons learned, smart panel applicability considerations, implementation challenges, installer observations, and preliminary analysis from operational data collected at installed sites. The webinar helped communicate early findings and encouraged continued collaboration among utility and implementation stakeholders.

The project team has executed CISR agreements for all nine Haven Energy sites to support two years of AMI data collection. In May, SCE announced that the BE pilot would sunset and that lessons learned would be integrated into the broader Energy Savings Assistance (ESA) program. This development accelerated timelines for recruitment and installation activities and created uncertainty regarding the completion of remaining BE pilot sites. In addition, although completed installations were performed safely and successfully, some installers demonstrated limited familiarity with smart panel commissioning requirements. Specifically, SPAN panel installations require any loads added after initial commissioning to be configured within the software platform to enable circuit monitoring and control functionality. In several cases, installers were unaware of this requirement, resulting in partially commissioned systems that may require follow-up work. The project team also experienced challenges collecting installer feedback through EPRI-developed surveys, as completing the surveys falls outside of installers' normal workflows and has led to slower response rates.

Next Steps

In the second half of 2026, EPRI and SCE will install the remaining smart panels – completing a total of nine through the SCE program pipeline and nine additional installations through the Haven pipeline. All of these panels will be SPAN smart panels, with a variety of model types specifically designed by the EPRI team and contractors to meet the electrical needs of each site.

The research team will also continue the assessment of the installation metrics and the electrical data collection and analysis. SPAN includes native circuit monitoring functionality that reports 1-minute power data by circuit and 1-minute whole premise current & voltage by phase. Once the panels are installed, commissioned, and added to the EPRI SPAN fleet data collection begins automatically. The team is already collecting data through SPAN at several sites and will ensure all sites have device metrology delivering data. In Q3 we have also requested AMI data for each

of the identified sites from SCE and we have recently received 2 years of data (June 2024 - July 2026) for 11 of the sites.

Next steps in the data analysis process will include analyzing the AMI data to get benchmark usage and load profiles for each site and comparing that to the SPAN data to see (1) where applicable: how SPAN data lines up with the AMI data and (2) how SPAN and the new end-uses/DERs are impacting load profiles. We will also use the SPAN data to evaluate the success of service upgrade deferrals by looking how loaded the panels are and if there are any "PowerUp" events.

DR25.12 EPRI Flex Refrigeration SPA (GFO-23-301)

Overview

SCE is collaborating with EPRI on a field demonstration funded by the California Energy Commission under an EPIC award to EPRI through GFO 23-301. The project integrates industrial refrigeration controls, thermal energy storage, floor-slab heating controls, and managed charging of the electric forklifts at a large, refrigerated warehouse to deliver demand flexibility and emissions reductions. The demonstration, referred to as “IndFlex”, focuses on a 45,292-square-foot cold-storage facility in South Gate, California, with a site peak demand of approximately 466 kW, providing a meaningful testbed for peak load management and load-shifting strategies that preserve product integrity and operational reliability.

The project will deploy advanced refrigeration system controls capable of receiving grid signals through a gateway or virtual end node, integrated phase-change-material (PCM) thermal storage to buffer refrigeration loads, smart controls for electric floor heating to coordinate defrost and slab temperature needs, and automated forklift fleet charging to avoid coincident peaks while maintaining operational availability. Together, these assets will be orchestrated to shift and shed load, reduce greenhouse gas emissions by at least 20 percent relative to baseline, and assess whether the combined solution can achieve a simple payback of less than five years, which are key adoption thresholds for industrial customers.



Industrial Flex Site Layout and Refrigeration Controls

Performance targets are defined per subsystem to enable replicability: refrigeration peak load reduction of 25 percent (low target) to 50 percent (high target); floor heating peak load reduction of 15 percent to 50 percent; and forklift managed-charging peak load reduction of 25 percent to 50 percent.

The project is co-funded under the EM&T Technology Assessments and Technology Transfer investment categories, as there are elements of both research goals in this study. The Technology Assessments category assesses and reviews the performance of DR-enabling technologies through lab and field tests and demonstrations designed to verify or enable DR technical capabilities. The Technology Transfer category advances DR-enabling technologies to the next step in the adoption process by raising awareness, developing capabilities, and informing stakeholders in initial stages of emerging technology development for potential DR program and product offerings.

Collaboration

EPRI serves as the prime and technical lead and is responsible for solution design, system integration, and multi-asset controls coordination. An independent M&V subcontractor will conduct pre-intervention baselining and 12 months of post-intervention measurement, enabling a rigorous evaluation of performance across operating modes, seasons, and grid signal conditions. Technology partners will support PCM selection and integration (e.g., commercial PCM manufacturers cited in the concept), the refrigeration controls upgrade with VEN-enabled signaling, slab/floor heating sensors and controllers, and forklift charging automation. SCE provides program alignment, DR/Auto-DR pathway coordination, and project oversight under the EM&T portfolio.

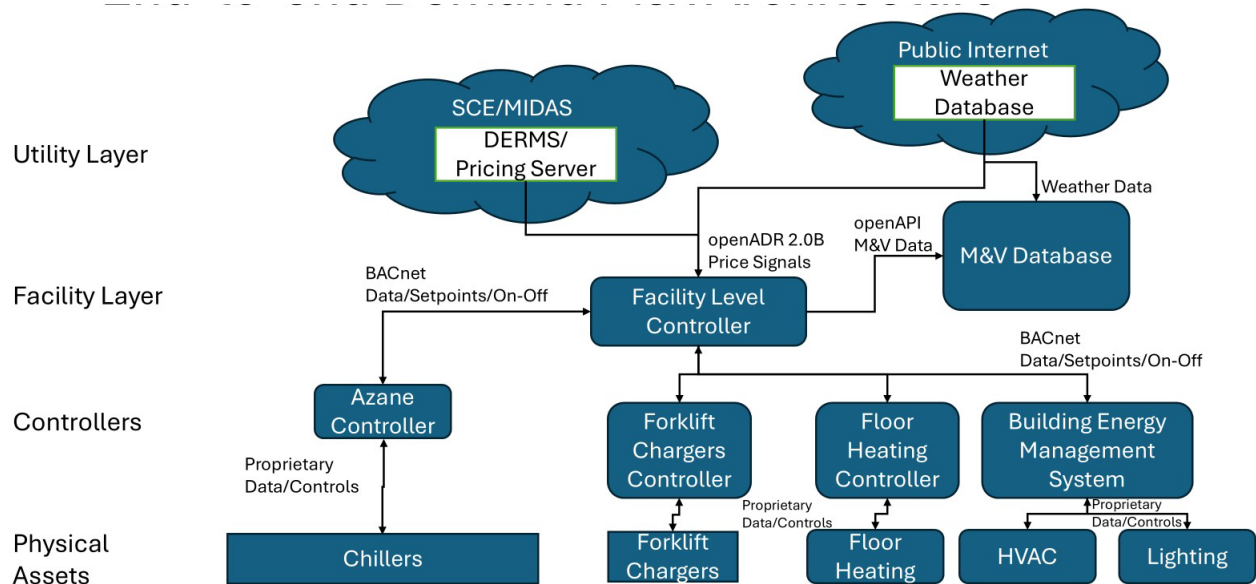
Results/Status

During the first half of 2026, the EPRI project team executed the collection of data for the baseline Measurement and Verification (M&V) for the IndFlex demonstration. EPRI and its M&V subcontractor continue to review the data from the installed M&V equipment to monitor and track the baseline system's performance, including metrics such as space temperature and humidity, refrigeration system power consumption, forklift chargers power consumption, floor heaters power consumption, and cold room door status. This information will be critical in understanding the impact of the upcoming refrigeration retrofit for the site. The demand flexibility benefits will have to account for any improvements in efficiency stemming from this retrofit when compared against the baseline data collected thus far will. EPRI continues to work with its subcontractors and the host site to determine a consistent and objective approach to evaluate the impacts this will have on the baseline data.

A key decision was made by the facility manager at the site to replace the existing legacy packaged refrigeration units with a new replacement integrated system. The EPRI team conducted several site visits to ensure the new refrigeration system can achieve the demand reduction targets on site. EPRI worked with the site and

identified a suitable subcontractor for the chiller design and installation, as well as the design and integration of a facility level controller.

Working with the end-use site and the subcontractor (refrigeration system supplier), the project team came up with the demand flexibility control architecture. The figure below shows the current architecture:



End-to-end Demand Flexibility Architecture

EPRI received the preliminary outline for control levels to be implemented in the facility level controller from a new vendor. The controller will utilize OpenADR and communicate with the various facility loads through MODBUS RS-485. A total of 4 levels of response were proposed, with increasing levels of load shed. EPRI has provided the following comments for revision.

- Ensure that the controller is compatible with OpenADR 3.0 and that the controller can interconnect effectively with all the refrigeration units, hot water heater and fork-lift charging stations.
- Add a "-1" level for pre-cooling or ramp up operation and outline the full range of chiller capacity for the price signal or ranges that will trigger each level. The current TOU structure can be used as the starting point.
- Add upper and lower bounds of freezer temperature to each level on the diagram.

EPRI and its subcontractor has completed a Baseline M&V Plan and Analysis Memo and continue to review the data from the installed M&V equipment to monitor and track the baseline system's performance, including metrics such as space temperature and humidity, refrigeration system power consumption, forklift chargers power consumption, floor heaters power consumption, and cold room door

status.

Next Steps

In Q3 and Q4 of 2026, the project will embark on the following activities:

- Finalize complete detailed design for the facility controller architecture, identifying vendors with suitable componentry, and complete procurement and programming of the controller.
- Install and commission of the new chiller, cutover from existing refrigeration chillers; integration of facility level controller.
- Install and integrate the Open-ADR gateway with facility level controller.
- Confirm SCE's Auto-DR connectivity, verify signaling interfaces with the MIDAS server, and establish commissioning of the automated control environment.
- Install any additional M&V instrumentation and begin the post-retrofit monitoring period for data collection.
- Get system ready for post-installation M&V, which is planned to start in Q1 2027.

3. Budget

The following table represents the total expenditures for SCE’s 2023 — 2027 EM&T authorized budget as of June 30, 2026. 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 I-2, SCE Demand Response Programs and Activities Expenditures and Funding submitted on February 2, 2026.

The values in the table below do not reflect forward budget commitments for internal labor, support contractors, or project costs, including those described in this report. The budget commitments may have been scoped and contracted but not yet executed or monies have not yet been spent.

Southern California Edison’s Emerging Markets and Technology Program 2023 – 2027	
Authorized Budget	\$25,743,335
Budget Spent to date	\$14,998,557

NOTE: The “Authorized Budget” amount in the table above also includes the 2022 funding authorized for the DR21.03 Dynamic Rate Pilot approved in D.21-12-015.