

DR21.04 Achieving Integrated and Equitable Decarbonized Loads with the CalFlexHub

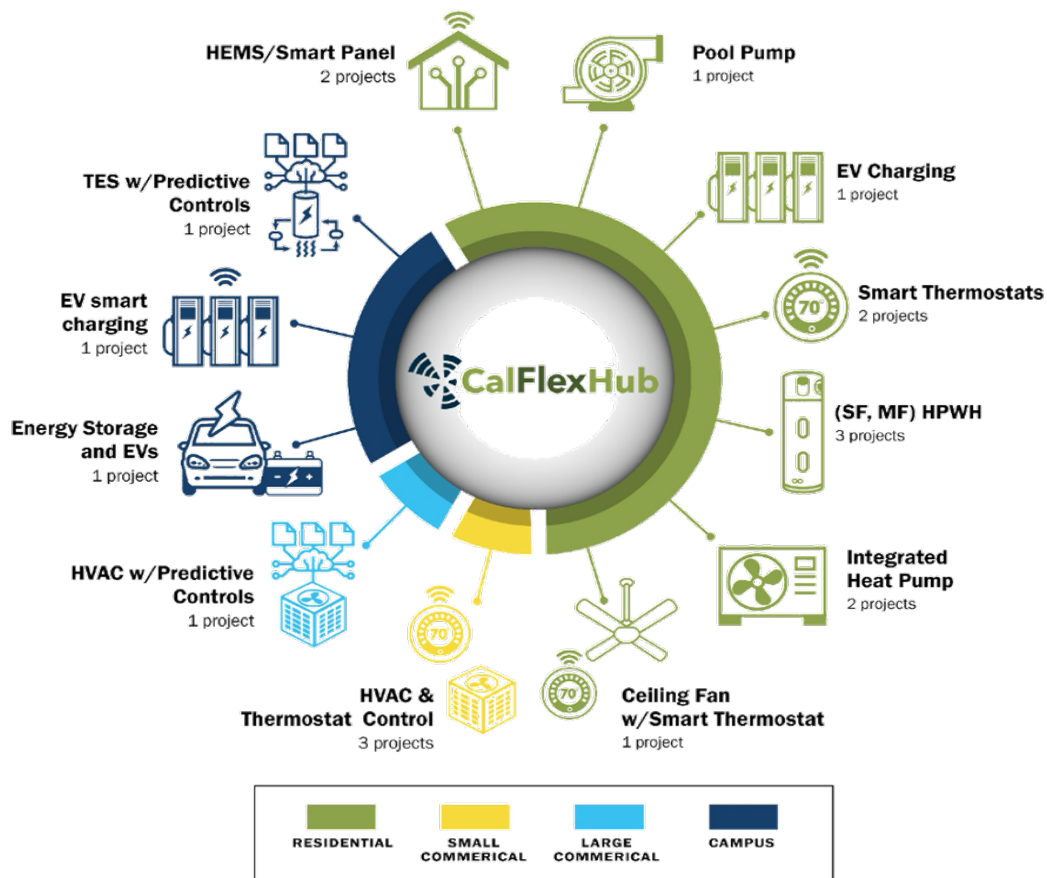
Overview

Lawrence Berkeley National Laboratory (LBNL) submitted a proposal to the California Energy Commission (CEC) in response to Electric Program Investment Charge (EPIC) solicitation GFO-19-309. The proposal was awarded a contract agreement (EPC-19-309) for a \$16,000,000 grant to fund the California Load Flexibility and Deployment Hub. Known in short as the CalFlexHub, its goal is to accelerate the understanding of how customer electrical end-use loads could provide dynamic load flexibility. CalFlexHub will achieve this understanding by demonstrating the technologies and incentives needed to provide that flexibility, and then increasing knowledge and understanding of specific customer needs through field research and customer surveys.

The EM&T program provided a Letter of Commitment (LOC) in support of LBNL's proposal for the EPIC GFO 19-309 solicitation. As stated in the LOC, SCE's participation in this project includes technical advisory support, active peer review of LBNL's applied research and development (ARD) activities during the project schedule, and match funding of \$600,000 to provide supplemental funding for SCE-specific projects in SCE territory or in SCE facilities.

In addition to the cash commitment of approximately \$150,000 per year for four years, SCE is also including its Energy Education Centers (EECs) and its Technology Test Centers (TTCs) as training and workshop resources (based on availability) for CalFlexHub interactive displays and exhibits, technical consultations, classes, seminars, and test beds to conduct small-scale testing in SCE laboratory settings.

The CalFlexHub program at LBNL will develop, demonstrate, and evaluate complementary technology platforms to actuate flexible loads using technology compatible with the CEC's Load Management Standards (LMS) platform, which will be used to communicate the prices, grid signals, and greenhouse gas (GHG) emissions signals. The LBNL team will pilot test and demonstrate innovative technologies compatible with the LMS platform to enable affordable flexible loads. Once technologies are pilot tested and usability research is complete, CalFlexHub will support commercialization of load flexible (LF) technologies that are proven to be usable and effective through completed field research.



CalFlexHub Overall Project Portfolio

LBNL intends to achieve the CEC's goals with a focus on the following objectives:

- Identify, develop, evaluate, demonstrate, and deploy cost-effective, scalable, load-flexible technologies that are consistent with building energy efficiency, appliance, and load management standards, to provide continuous load shaping from dynamic prices and GHG signal response.
- Create a portfolio of LF RDD&D technology projects across various building types and sizes including single family residential, multi-family, commercial buildings, and integrated campuses. Evaluate the performance of integrated control and optimization of these technologies to reduce customer bills and GHG emissions.
 - These technologies include building electric end-uses and other DERS such as PV, thermal and electric storage, and EVs.
- Deploy LF technologies to demonstrate the ability for electric customers to receive the LMS price and marginal GHG signals at five-minute increments and report statistically significant effects. Demonstrate that load-responsive technologies can receive and respond to signals via open secure protocols.
- Identify ways to improve usability of technology solutions to increase customer

benefits. During deployment, score the usability of each LF technology on a statistically supportable sample of customers using the System Usability Scale (SUS) and collect input from customers and end users to develop strategies to improve device usability and customer engagement strategies.

- With an Equity First strategy in CalFlexHub, evaluate and demonstrate key technologies for disadvantaged and vulnerable communities to overcome financial and health burdens, and develop plans to build scalability through innovation and targeted deployment of those technologies.
- Develop a database of key performance metrics, including the usability for flexible technology and strategy pathways and generate these metrics for 2025, 2030, and 2040 scenarios. Publish summaries as part of the annual report for CalFlexHub stakeholders. Evaluate how these technologies perform in the CalFlexHub field tests.
- Develop and deploy the CalFlexHub Solutions Center website and a clearinghouse to disseminate information, technology reports, and case studies to report on “what works,” sharing California and national RDD&D. Create a sustainable partner engagement platform and stakeholder engagement ecosystem and develop a Technology Transfer Best Practices Manual for CalFlexHub Innovators.

SCE will work with the LBNL team on the scope of individual activities that are specific to SCE’s strategic load management interests. While SCE is included in the project’s Technical Advisory Committee (TAC) meetings as part of their role in the project along with other qualified professionals in accordance with the CEC’s contract with LBNL (EPC 19-309 Agreement), SCE will also actively facilitate a dynamic “real time” technology information transfer of the knowledge gained, experimental results, and lessons learned from the project.

SCE will receive early-stage drafts of any project related documents and deliverables, specifically those documents that will help SCE bring these technologies into their program offerings. Specifically, SCE will receive the following during the execution of the project:

1. Copies of the monthly progress reports submitted to the project’s Commission Agreement Manager (CAM), per EPC 19-309, Task 1.5
2. Drafts and final copies of reports as specified in the SCE Specific Deliverables
3. Meetings and online seminar updates as specified

SCE will also receive three to five project updates, preliminary findings, and completion meetings, via online seminar in accordance with a schedule mutually agreed between the LBNL project team and SCE to support the technology transfer

of project activities for SCE's internal stakeholders.

SCE is interested in identifying "off the shelf" measures in the Technology Demonstration and Deployment (TDD) projects. The research performed by the CalFlexHub in the TDD stage should focus on technologies with a current technology readiness level (TRL) between 6 and 8. TRL 6 is used as the level required for technology insertion into system design and normally the last stage where technology has been demonstrated in the engineering/pilot scale in the relevant environment.

The goal of CalFlexHub is to move these technologies up one or more readiness levels by the end of the project. TRL 8 is the actual system operational and qualified through demonstration, wherein the technology has been proven to work in its final form and under expected conditions. SCE engineering staff will assist with the step up from laboratory scale to engineering scale and the determination of scaling factors that will enable the operating system's design.

The project is funded under the EM&T Market Assessments and Technology Assessment 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 the LBNL CalFlexHub research team, with SCE staff acting as advisors and active reviewers of the work in progress. To facilitate enhanced knowledge transfer, key members of SCE's project team will collaborate with LBNL engineering staff and researchers to provide insight into and influence over each project's initial design and direction throughout its duration.

SCE engages other industry stakeholders and subject matter experts to 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. In addition to the TAC meetings, SCE will receive more timely updates for ongoing consultation and access the reports and deliverables produced for the CEC contract advisors.

Results/Status

With the SCE/LBNL agreement executed in Q3 2023, several CalFlexHub check-in meetings were conducted in Q3 and Q4 of 2023. SCE was provided with materials supporting the first two project deliverables as per the master agreement task order.

- Kick-off presentation with summary overview of the CalFlexHub overall project, its goals, and specific tasks planned for research.
- Project Abstracts Summary Document was provided, with proposed Research Area Topics outlining key sub-projects for focused engagement with SCE, including:
 - Demonstration of AI load flexibility software integrated with building controls.
 - Demonstrate AI software's ability to help small to medium commercial facilities shift load in response to hourly electricity prices.
 - Expand beyond the demonstration scope currently in CalFlexHub by including EV charging and/or stationary battery in AI-load-flexibility-software-managed loads.
 - HPWH Load Shifting
 - Connect HPWHs to advance cloud-based load shifting controls.
 - Demonstrate cost-savings of LBNL's price- and load-responsive HPWH load shifting controls.
 - Heat Pump Water Heaters and Training Center Support/Demo
 - Connect HPWHs in SCE's Energy Education Center testing facility to advanced load shifting controls.
 - Prepare demonstration and educational materials for SCE to use in training seminars.
 - Multifunctional Customer Gateway including Legacy Load Optimization
 - Demonstrate a working prototype multifunctional gateway that takes in prices with OpenADR 3.0 over a cellular connection (5G) and develop functional control of connected devices to provide load flexibility. This will be based on a current vendor gateway that currently supports Wi-Fi, Bluetooth, Zigbee, and Z-Wave.
 - Large Thermal Energy Storage
 - Determine the potential opportunities and obstacles associated with using large thermal energy storage (TES) system in SCE territory for responding to prices and other demand flexibility events.

- Develop, deploy, and test advanced control algorithm modeling to better understand TES effectiveness in delivering demand flexibility.
- Price-responsive controls review
 - Review existing HVAC control products and third-party software platforms available in the market that can respond to price signals and analyze their compatibility with SCE infrastructure.
 - Establish new requirements for “price-responsive” communication and control interfaces, which can serve as eligibility criteria for products participating in SCE programs.
- EV Charging Collaboration
 - Examine opportunities for EV charging as a critical flexible load resource
 - Leverage LBNL’s work on EV smart charging vision for DOE to inform SCE on its strategies for EVSE load management.

Next Steps

LBNL and SCE will continue their coordination and planning of the refined sub-project scopes listed above and finalize the desired scope of work and research outcomes through Q2 2024. Deliverables including project check-in/completion meetings, Technical Advisory Committee updates, and preliminary data reporting, are ongoing. Some selected projects specific to the SCE collaboration effort are expected to begin in Q1 - Q2 2024. The overall CalFlexHub Project at LBNL is scheduled to continue through 2025.

