SCE EM&T PROJECT: DR19.02 LOW-INCOME MULTI-FAMILY BATTERY STORAGE, SOLAR PV, AND DATA COLLECTION

Status: In progress

Overview

Battery Energy Storage Systems (BESS) and solar PV systems are being integrated into Multi-Family, owner-managed residential building portfolios at a growing number of sites across California. This project is designed to assess how 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 DER installations, improve the models for grid infrastructure design and planning, and gain experiential data from these customer assets for new models of DR.

Zero Net Energy Multifamily Low-Income Facility

This project is designed to provide research related to the interconnection, commissioning, system performance, customer objectives, and grid impacts of the installed energy storage system and PV array installed at Pomona Mosaic Gardens and provide knowledge transfer for similar energy storage projects. The multi-family housing complex at Pomona Mosaic Gardens has been identified by SCE's Emerging Markets and Technology (EM&T) research program as a key venue to test

and validate function, operation, and value of battery energy storage in the context of PV solar and customer loads. The proposed project endeavors to characterize the changes in the building's load shape and grid impact qualities associated with behind-the-meter (BTM) customer-sited energy storage.

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 to provide grid-responsive services, "shift" for dynamic pricing response, or backup energy. The focus will be primarily on storage acting as a DR resource.

Battery Energy Storage System in Multi-Family Building

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 performance and its benefits and 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.

Performance testing of the paired solar and energy storage solution can provide SCE with valuable information on the characteristics of the building energy storage system with islanding inverters, as well as its impacts on the customer building

performance and the local grid equipment. SCE's research interests in customer-owned storage are emerging and broad, and as customers increase their adoption of solar plus storage systems at the multi-family level, SCE seeks to understand how these systems can:

- Create incremental grid value in locations with demonstrated needs (e.g., areas with reliability-related service interruptions, distribution circuits experiencing high loads, etc.)

- Create incremental customer value above the typical use case for PV-paired battery systems. Efforts may help to unlock additional customer value streams (e.g., satisfaction, incremental customer revenue streams from grid deferral, etc.)

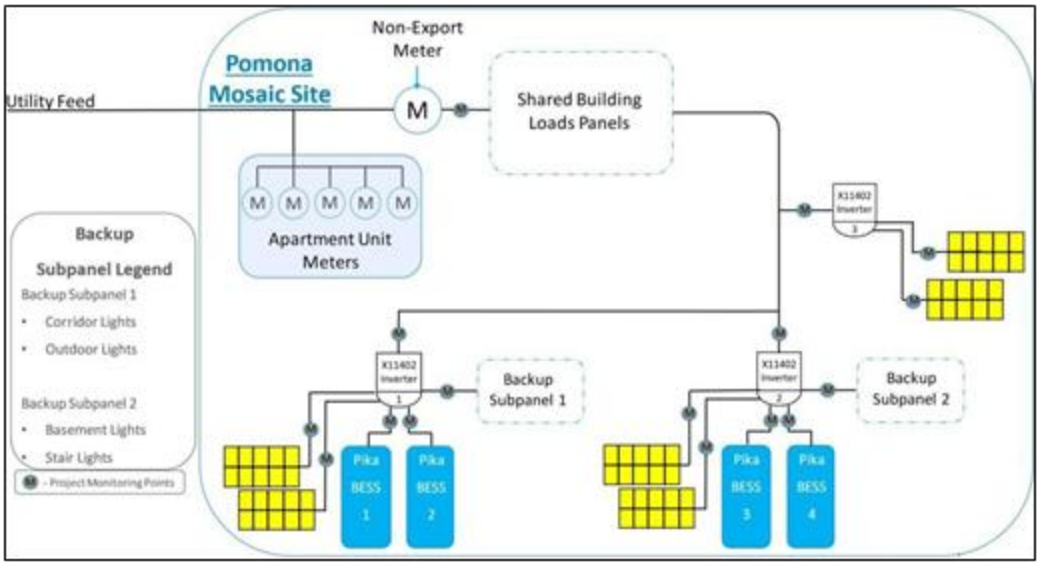
- Assess Product Design and Cost Assessment: What are the features of various products and total cost of ownership? How do storage products installed in the field perform in comparison to manufacturer specifications and owner expectations?

- Achieve Technology Readiness: Are products able to be safely and reliably deployed with robust operations? What are actual deployment experiences, as well as standards and requirements that apply for installation, safety, operation, monitoring, and integration?

- Document Real-World Operating Conditions: How do storage products operate and what is the resource availability outside of standard lab conditions in real-world environments, including weather extremes and conditions exceeding manufacturers specifications?

Performance assessment of electric storage at a high-efficiency "zero net" building to better understand the issues posed will be accomplished by first developing a detailed test plan which will characterize the energy storage system itself, as well as grid service-based operations and customer service-based operations. Several dispatch strategies will be examined, as well as assessing which secure communications approach and set of protocols are applicable.

The specific assessment of the energy storage system as both backup and as a distributed energy resource (DER) will include characterization of round-trip efficiency, battery module degradation, depth of discharge, and power capacity at variable states of charge. Grid service characterization will cover non-export constraints, and recommendations for potential modifications to the control and operation of this and similar energy storage systems. Retail energy time-shifting and solar self-consumption services are often considered customer services but can provide as much or more benefit to the utility as well.



Solar/Storage Electrical Overview with Smart Inverters

The primary objectives of this project are to demonstrate how customer storage can be leveraged and to quantify impacts to both customer and grid stakeholders. The research focus will cover the following areas:

- Interconnection for non-export systems: providing lessons learned and best practices that developed during the initial phase of the project

- Characterization of battery modules under operation in accordance with the dynamic pricing schedules and opportunities for demand response impacts

- Grid Control Strategy: understanding the objective of the parties involved, grid services, customer applications, and how certain control modes are focused on achieving one or the other, or both simultaneously for load balancing

- System Performance: evaluation of efficacy of energy storage systems and software regarding:

    - Control and communication, both local and remote

    - Grid services and tariff compliance, and customer uses and applications

- Economic Analysis: characterization of customer economics and grid benefits associated with this system, and similar optimized systems, based on specific control strategies and values such as deferred costs and loss of load

This project will be executed in several phases. It begins with the completion of the battery and solar interconnection and proceeds to design validation to ensure interconnection was completed as intended. Any issues found are reported and repaired, issues can be used to guide SCE's future work with customer-sited energy storage, and M&V can be achieved accurately. The research team will also advise on appropriate installation techniques, including appropriate metering to achieve project objectives and the appropriate choice of backup loads chosen to ensure appropriate results. This will help to achieve test objectives, while providing the customer facility with resiliency during power outages.

The project was 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, including raising awareness, developing capabilities, and informing stakeholders. This occurs during the early stages of emerging technology development for potential DR program and product offerings.

Collaboration

This work is a collaboration between two SCE groups — the EM&T program and a team of technical experts from SCE's Transmission and Distribution Strategy group, with support from Kliewer and Associates for field work and oversight. The building owner is LINC Housing which has a 37-year history developing multi-family housing for elderly and low-income residents and is an active and supportive participant in the work. 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, interconnection (non-export) and value characterization of the BESS installed by SCE.

While the research and storage systems are funded by the EM&T program, SCE is leveraging its membership in EPRI with learning and best practices from the parallel research by other EPRI utility members as a cost-sharing strategy. Also, as a corporate funding member of EPRI, SCE is co-funding parallel research investments with other utilities and leveraging that research to assist in this market assessment study, but no other direct cost-sharing or co-funding with any other parties was enabled.

Results/Status

The BESS installation contractor (Promise Energy) needed to make modifications to the M&V design and include additional monitoring equipment in mid-2020 in order to receive Self Generating Incentive Program review, as the approval for Permission to Operate (PTO) was previously attained. These additions also enabled the use of additional advanced control monitoring to facilitate the testing criteria established

by K&A and EPRI. COVID-19 restrictions delayed the installation of additional equipment required for the EPRI work and slowed progress through the end of Q3 of 2020.

The BESS and associated solar system are currently operational at the site and some limited round-trip efficiency tests have commenced. During the initial battery tests during Q3-Q4 2020, it was determined that the inverter cores should be upgraded to the latest Generac cores from the original PIKA cores. This core replacement was accomplished by the end of Q4 under warranty but impacted the test schedule with further delays, as travel and access were limited until California COVID-19 restrictions allowed for more detailed site visits for all personnel.

Highlights from testing the BESS include:

- Round trip efficiency testing indicates battery efficiency, available power at varying states of charge, and capacity degradation over time.

- Thermal impacts of battery operation and environment can impact reliability of individual and aggregated systems in the field.

- Time to full discharge indicates the capability of the BESS to back up essential building loads as well as provides opportunity to support the grid through peak pricing time-of-use scheduling.

Next Steps

EPRI and K&A are planning to continue the battery testing going forward in Q1-Q2 2021 utilizing the planned test criteria previously developed in a customized test plan. This effort will complete the M&V design, installation, and commissioning of the auxiliary BESS monitoring and verification equipment in collaboration with the BESS vendor, the installing contractor, SCE's interconnection group, and the building owner, LINC Housing, under the current COVID-19 safe work practices. The testing data will be provided to the Self Generating Incentive Program inspector in order to pass the field verification and to successfully attain approval to enable the customer to receive SGIP incentives.