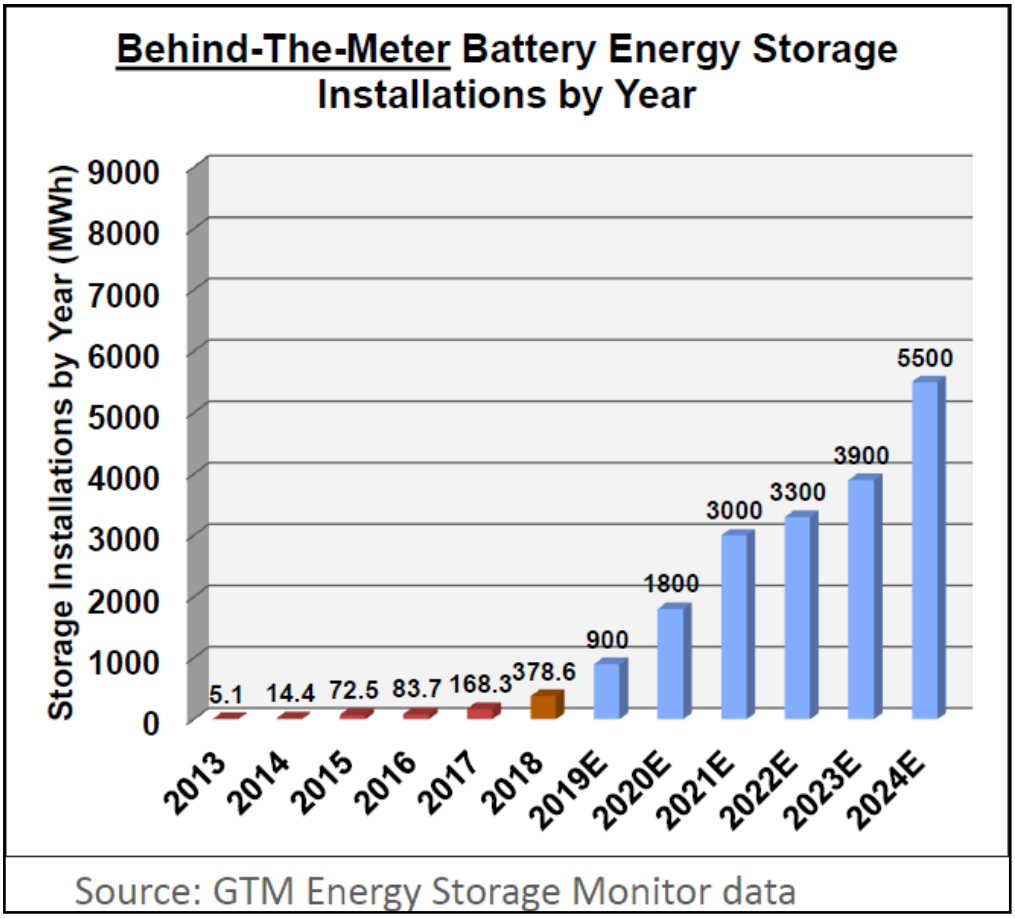
DR18.05 Residential Energy Storage Study

Overview

Customer-sited battery energy storage products are emerging quickly due to cost and performance improvements in lithium-ion battery technology, and government and utility programs that support grid resilience and improved integration of renewable energy. Storage may be adopted by customers for electric bill savings, backup power, or increased use of local renewable energy. As a result, electric utilities are increasingly faced with the opportunity to interface with customer-sited storage systems, either as interconnected devices or potentially as shared resources with multiple uses.



GTM Energy Storage Monitor Data

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

The flexibility of the battery to either charge or discharge on short notice has a huge advantage as it can store energy for later discharge and thus accommodate more variable solar generation. It is important for utilities to understand the systems being interconnected to the grid from functional, safety, and power quality perspectives. The EM&T program developed a project to examine the application of retail tariffs with highly dynamic prices for energy storage and explore the automated dispatch of storage to address customer economics and grid operational issues, with an emphasis on demand response capabilities for shift and shed.

The Residential Energy Storage (RES) project has been identified as a venue for testing and validating behind-the-meter energy storage system functions such as load shifting and demand response load reduction. LG Chem batteries with SolarEdge inverters have been installed at three homes, and an additional unit has been installed in an SCE Smart Home. The proposed project allows for the extension of concurrent and previously established research to gain a comprehensive understanding of the technical performance of the system as well as the benefits and impacts for both the customer and grid operator.

Residential Battery Storage System Under Assessment

Another goal of the project is to better understand how smart inverter APIs can demonstrate the monitoring and automated control of behind-the-meter residential batteries for grid support, demand response, and price elasticity to dynamic tariffs. This

project will assess the performance of three residential lithium-ion batteries with SolarEdge smart inverters that have been installed and commissioned in the Moorpark area. The research will also address some important overarching issues around how SCE can include behind-the-meter battery systems to meet the local needs for grid-interactive communities to ensure distribution upgrade affordability, reliability and resilience, and environmental performance. These include the following:

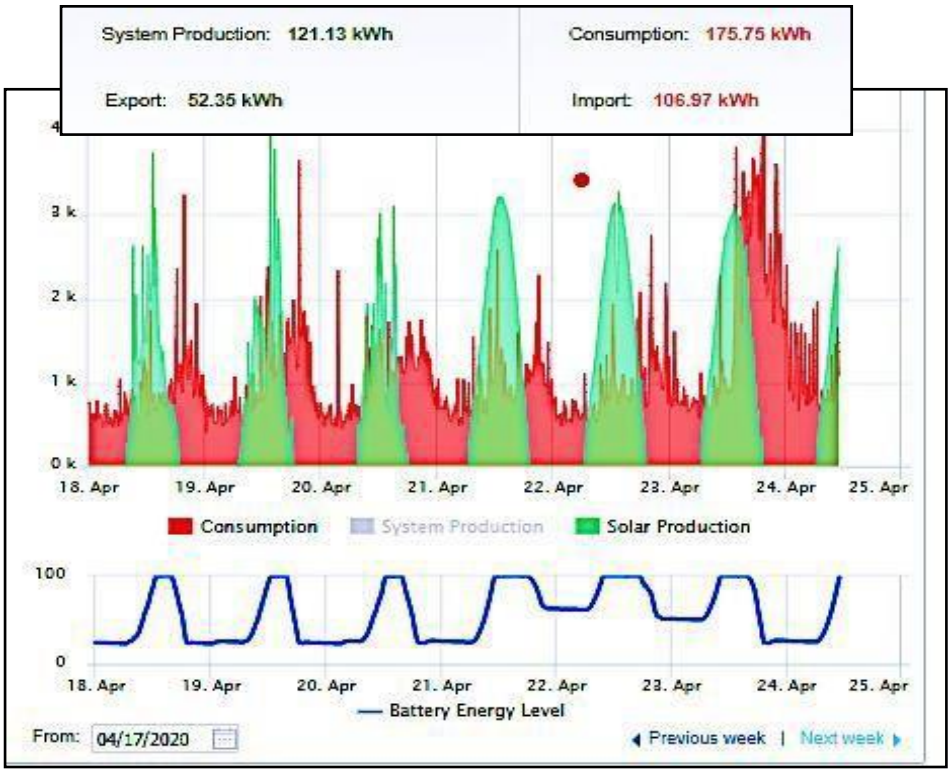
- Dynamic Management: Building end-uses can be designed to help meet grid needs and minimize electricity system costs, while meeting occupants' comfort and maintain lifestyle productivity.

- Resource Co-Optimization: Device design prioritization with buildings to provide greater value and resilience to both utility customers and the grid.

- Integrated Value: Energy efficiency, demand response, and other services provided by facility resources.

The research outcomes from this project will prepare SCE and its technical stakeholders for the 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. The research team will develop a test plan that will examine the following:

- Charge and Discharge Setpoints: The ability to accurately schedule commands for the battery system to charge and discharge are paramount for end users, utilities, and permitting jurisdictions to rely on the further installation of energy storage systems in this and other behind-the-meter contexts for the future.
- Retail Energy Time Shift: Battery energy storage systems can be used to reduce electric bills by using stored energy during times when the retail rate for energy is highest. Given that the utility prices the tariff based on marginal costs for providing power to a facility, this use case and application has potential benefits to both the customer and distribution system. The test plan, however, will examine how to maximize customer benefits in accordance with the TOU-D PRIME rate from SCE.



Residential Battery Storage System Charge/Discharge Profile Alignment with SCE Tariff TOU-D-Prime

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 by raising awareness, developing capabilities, and informing stakeholders during the early stages of emerging technology development for potential DR program and product offerings.

Collaboration

SCE is leveraging three residential participants from a previous CEC EPIC grant project, who have allowed the battery energy storage system (BESS) to be installed by a third-party systems integrator. The BESS includes a SolarEdge smart inverter system, and the LG Chem RESU battery panel installed by Promise Energy. Kliewer & Associates has facilitated the system commissioning and city/county inspections of each home and is currently developing a training module for the grid interactive SolarEdge API that will enable SCE engineering staff to schedule the systems for grid-responsive flexibility testing. The project is wholly funded by the EM&T program and no co-funding or cost-sharing with other utilities, private industry, or other third-party groups was requested or received for this project.

Results/Status

The project encountered numerous challenges, some of which were resolved, and others that require future attention. Implementation issues were encountered that pertain to:

- Supply of equipment for installation, due to delivery constraints
- Reliability of equipment during installation and BESS operation
- Training gaps for both permit inspectors and installers of the equipment
- Equipment design and firmware changes not documented by the manufacturer

Interim project results indicate that the BESS control and monitoring are hampered by inadequate technical information and market barriers:

- Support for control of BESS equipment is not as comprehensive as advertised, and some aspects may be proprietary and not accessible for broader Internet of Things (IoT) support.
- The proprietary nature of BESS equipment limits customers, or other non-manufacturer parties, to control because of expensive licensing costs that are not apparent prior to purchasing equipment.
- Security firewall barriers may require additional equipment and/or programming to align with the manufacturer's protocols.

The final project findings from the collection of data, commissioning evaluations, and systems integration testing garnered the following recommendations:

1. Careful implementation of BESS installations accompanied by thorough commissioning of BESS systems is required for optimal control and savings. Every system had an issue that needed to be corrected after the BESS installations were "completed" to achieve proper operation and control. Consider, for example, adoption of a requirement (Rule) for a third party such as a HERS Rater to certify BESS installations.

2. The ability to troubleshoot BESS installations for optimal control is beyond the capabilities of most homeowners and many installation contractors. Inspectors do not have the time or training to know what to look for. A certification to qualify the installation of each manufacturer's product would be helpful; an independent third party may be necessary but would need to be sanctioned as a requirement to be effective.

3. It was common to experience unintended consequences such as charging BESS systems during grid congestion. More safeguards may be required to prevent such issues, including hardware or software lockouts.

4. The TOU-D-Prime tariff was found to be very effective for reducing energy costs provided the BESS was aligned accordingly with scheduling. More work needs to

be done to fully understand and document the behind the meter savings to customers as well as the grid supporting effect of aggregating BESS customers.

5. It was found that single-battery (Li-Ion) BESS systems frequently did not have enough capacity to extend throughout the entire peak pricing TOU. Additionally, after completing the discharge cycle, the BESS systems had little reserve to provide meaningful backup power should a grid outage occur. Controls to adjustthe rate of charge/discharge for BESS systems would be helpful to schedule reliable operation of BESS systems to support the grid. Additionally, tools to model storage modes would be helpful for proper BESS system design.

6. Response to PSPS events should be a fundamental strength of a BESS. However, if the timing of the PSPS coincides with late BESS TOU discharge, littleif any reserve capacity is available for critical loads backup. Anticipation and automated response to PSPS events is critical for optimal customer use of BESSfor backup load response. Barriers currently exist that prevent automated response of BESS to PSPS. More work (research and testing) needs to be done to enable effective automated control of BESSs to respond to PSPS events.

7. The project identified the need to drive technology and market solutions to remedy the barriers that protected manufacturer APIs bring to the table reducingthe integration of various technologies to support user needs and adoption of flexible demand response and pricing strategies.

Next Steps

SCE is continuing analysis of data collection and interval data, and rate analysis. SCE intends to complete the analysis by Q3-Q4 2021. Upon completion, the finalreport will be uploaded to the Emerging Technologies Coordinating Council collaborate website.