GO solar CALIFORNIA

CSI RD&D PROGRAM

Grid Integration

Grantee:
Energy and Environmental Economics

Partners:
Sacramento Municipal Utility District, Sunverge, Rocky Mountain Institute

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$717,500

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2014-2016

RD&D Project Portal:
calsolarresearch.ca.gov/csi/108

Itron | CSI RD&D PROGRAM MANAGER

Photovoltaic Integrated Storage: Demonstrating Mutually Beneficial Utility-Customer Business Partnerships

OVERVIEW AND OBJECTIVES

As photovoltaic integration and energy storage become more pervasive on the utility electrical grid, efforts to quantify both the electrical and economic impacts of these technologies are necessary to support widespread distributed energy resource (DER) infrastructure development. The Energy and Environmental Economics (E3) team conducted research on the distribution grid impacts and economic benefits of behind-the-meter PV integrated energy storage deployed at residential customer sites in the Sacramento Municipal Utility District (SMUD). The E3 team leveraged Sunverge's home Solar Integration System (SIS) units in their analysis of demand response during the summer and fall of 2015. These units combine battery storage with a power management platform to provide power and financial benefits to consumers and utilities. Additionally, the team analyzed grid operations throughout a year and modeled the economic benefits. The project aimed to develop robust estimates for local distribution systems, overcome near-term cost barriers by demonstrating long-term customer and utility benefits from energy storage, and translate those savings and estimates into tangible policy and planning recommendations.

METHODOLOGY

Thirty-four homes in an innovative zero net energy housing development in Sacramento were selected to host SIS units for analysis during both typical demand cycles and critical peak pricing (CPP) events. Seventeen events were tested, and both participating and non-participating customers' electrical data were analyzed at one-minute time intervals. Participating customers had their backup power reservation reduced from 40% to 25% state of charge, leaving more energy available for dispatch during peak hours.

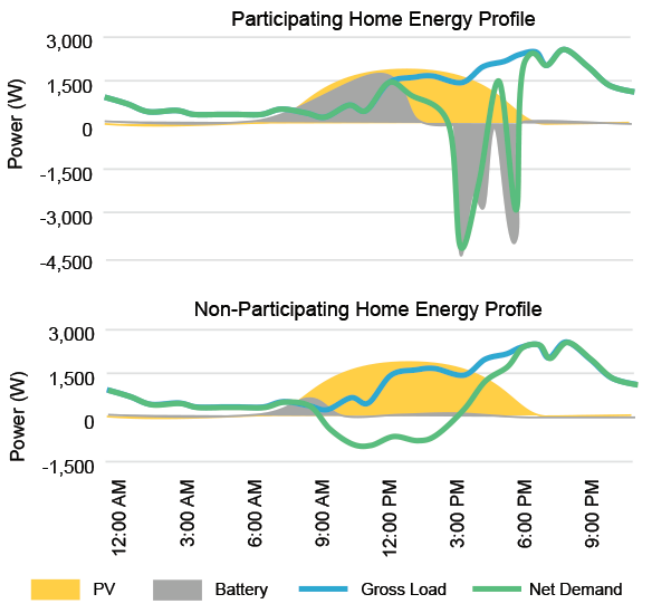
Because of complications regarding accurate calibration of SMUD distribution system models, only a single circuit encompassing two feeders was modeled and analyzed. This modeled circuit and two simulations of the circuit, adjusted to add PV systems with and without SIS units, were analyzed for economic benefits under a wide range of circumstances.

This document provides a brief project description. For more detail on the project and the California Solar Initiative's (CSI) Research Development, Demonstration & Deployment (RD&D) Program, please visit calsolarresearch.ca.gov

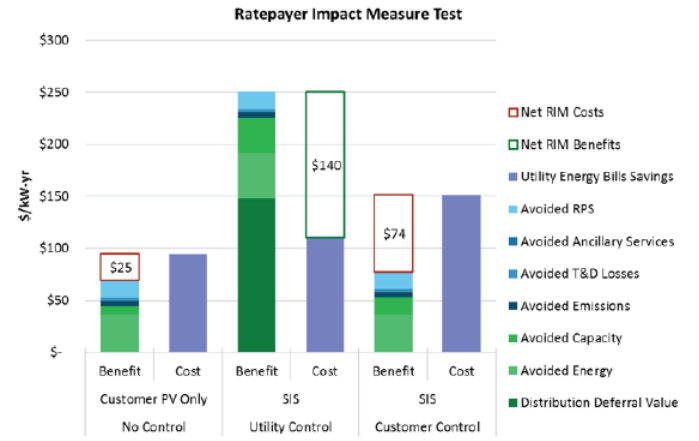
The CSI RD&D Program is managed by Itron on behalf of the California Public Utilities Commission (CPUC).

RESULTS AND OUTCOMES

The grid demonstrations of CPP and demand response events resulted in storage dispatches that lowered net demand during peak hours, thus reducing overall grid demand and avoiding payment of peak prices for the customer. The figure below shows the 24-hour profile during one such CPP event averaged over all participating homes and non-participating homes. The batteries for participating homes were charged until full at about 2:00 PM and discharged during the event, from 4:00 to 7:00 PM. Non-participants operating under standard time-of-use rates experienced battery top-offs before 10:00 AM with continuous discharge and grid exportation. Participants experienced average load decreases of about 2.2 kW and 6.5 kWh, about 80% of available energy storage, and the PV generation available to charge the battery exceeded battery capacity during all but one event.



Average SIS participating home energy profile and average non-participating home energy profile during a CPP event



Benefits and costs of PV + storage systems under utility and customer control for one simulated feeder. While customer control of batteries doesn't result in net savings on an annual basis, there is great potential for savings under utility-controlled systems.

The team analyzed the cost-effectiveness of SIS in three scenarios: stand-alone PV without storage, customer-dispatched storage, and utility-dispatched storage. Each case was also rated on its ability to delay the need for transformer upgrades. As expected, the nature of PV generation during off-peak hours means that PV alone does not defer the upgrade, however the model simulating the usage of 34 SIS units deferred the upgrade for five years for a benefit of $148/ kW-yr for each kW of energy storage. Analysis of cost-effectiveness resulted in net losses under four scenarios (two feeder substations, under both utility and customer storage controls), indicating that SIS procurement costs are greater than the benefits of ownership. The costs and benefits to the ratepayer for each scenario are shown above.

PUBLIC BENEFITS

Economic: SIS units can provide both utility and customer benefits during peak pricing periods and can defer expensive substation upgrades until further funding is secured. However, they may not be cost-effective enough to recover the cost of equipment and installation in some locations.

Load Reduction: Reduced stress on grid due to discharge of SIS storage systems, in conjunction with PV, eases flow of energy on the grid during peak hours and results in greater overall efficiency.

Utility Support: Dispatch would allow for charging off the grid in the mornings of high load, low PV generation days and increase the reliability of the system, benefiting utilities.