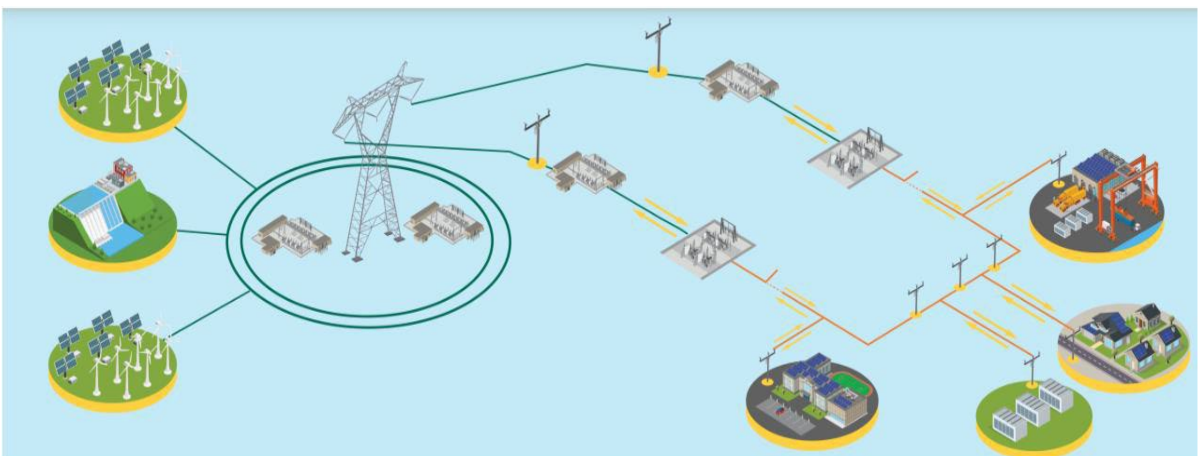
DR19.05 Virtual Power Plant Project

Overview

Depending on the specific application and use case, Virtual Power Plants (VPPs) can accomplish a wide range of tasks to aggregate distributed energy resources such as solar panels, distributed generation, and battery storage, in order to monitor, forecast, optimize, and trade their power. Distributed VPPs can work in concert with centralized, utility-scale renewables to ramp up and down either the power generation and/or power consumption of controllable DER units through third party services. The VPP network not only helps stabilize the local power grid but also creates the preconditions for integrating renewable energy into the markets. By aggregating the operation of many decentralized units, a VPP can deliver the same service and redundancy and subsequently trade on the same markets as large central power plants or industrial consumers.



Current Grid Architecture Example with Distributed Energy Resources

The VPP network in this project utilized residential behind-the-meter (BTM) battery systems to demonstrate the ability to provide pre-scheduled demand response grid services. The VPP aggregator enrolled 200-500 customers from a population of 1,000 customers with PV-paired battery systems. Customers with batteries typically use the systems for TOU rate arbitrage and emergency backup services when the systems are not providing demand response grid services. For the pilot, SCE executed demand response events by dispatching signals to the VPP integrator via the SCE demand response automation system (DRAS). Customers were then compensated for their participation and were able to override events.

This project was overseen by the Demand Response Operations Pilots group, and a portion of the M&V cost was 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

The SCE EM&T Program role was to provide supplemental funding for the SCE contractor overseeing the measurement and verification process for the VPP project team. Their scope was to identify potential use cases for demand response grid services from the PV-paired battery storage systems involving management of SCE system demand on a day-ahead basis, management of local distribution system demand on a day-ahead basis, and SCE system or local distribution system demand management on a day-of or emergency basis. The potential use cases SCE tested will provide data on future demand impacts in kW per dispatched battery system.

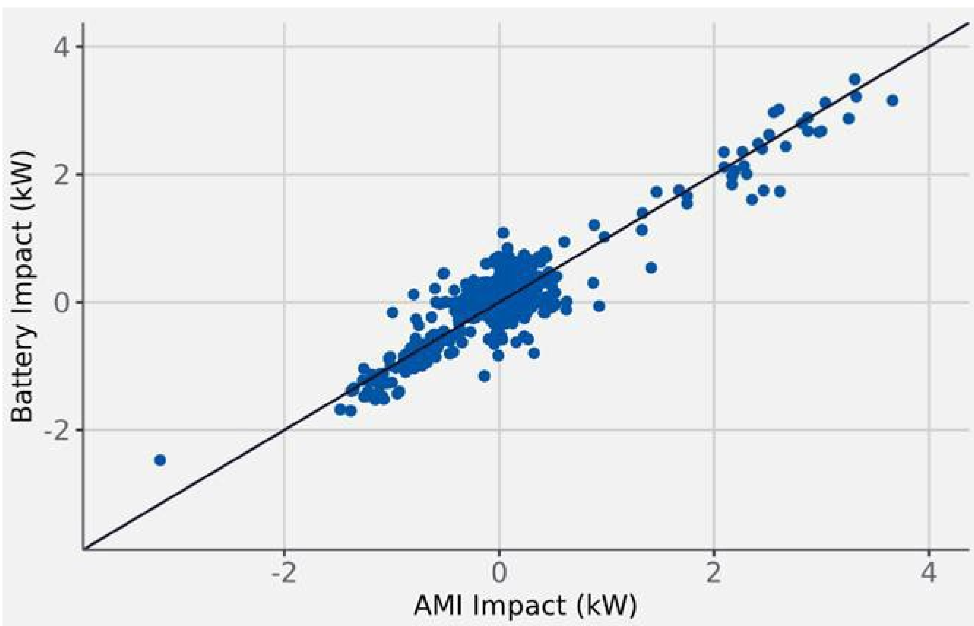
SCE VPP Project had the following research objectives for the pilot:

1. Can the third-party VPP aggregator provide the grid services in the required amount and when the services are needed?
2. Does the operational process to dispatch BTM batteries work as expected?
3. What is the persistence of savings during events?
4. Which of the potential use cases do the pilot outcomes best support?
5. What MW capacity does this pilot provide and what are the technical performance characteristics of PV-paired battery systems?
6. How integrated are Sunrun controlled PV-paired battery systems with SCE's demand response management system?

Results/Status

A total of 275 eligible customers participated in the pilot. The test procedure involved seven demand response scenarios (use cases) with different start times and durations, each partially overlapping with the 4 p.m. to 9 p.m. on-peak window, during which the customer's batteries are programmed to discharge daily. The evaluation estimated the electricity demand impacts of demand response at the utility customer's meter and analyzed the battery and solar PV system telemetry data to assess battery performance during demand response events.

VPP demand response event impacts were evaluated against a baseline of the demand of SCE residential customers not enrolled in the pilot (nonparticipants). The VPP Pilot generated demand savings in most hours, except for the hour beginning (HB) at 5:00 p.m. VPP dispatched load reductions during HB 5:00 p.m. were not realized largely because batteries normally discharge most of their energy during this hour. Savings in other event hours averaged 0.62 kW per participant. Researchers compared demand impact estimated using customer AMI meter data and battery telemetry data and found that the analyses produced remarkably similar demand impact estimates from both sources. In addition, the AMI meter and battery telemetry demand impact estimates were highly correlated (simple correlation coefficient=0.91). The accuracy of the VPP demand impact estimates based on analysis of battery telemetry data suggests such data can be used in future impact evaluations.



Battery Telemetry vs. AMI Impact Estimates

As residential batteries provide a limited amount of capacity since most SCE residential customers utilize their batteries to manage their TOU rate charges, the VPP pilot resulted in smaller average demand response impacts than expected. Future VPP projects will need to manage battery charging and discharging timing to optimize VPP performance during DR event periods.

Next Steps

The engagement and support of the EM&T program for this project was limited to co- funding the verification study for assessing the load impacts of the Pilot. The VPP Final Project Report will be available on the DRET Website in Q2 2023.