Residential Battery as Virtual Power Plant (VPP) Study

1. Overview

This study evaluated how BTM residential battery systems were being used to provide value to the customers and the grid during grid emergency. The study focused on customers with existing battery with solar.

The objective of the study was to evaluate:

1) What are the ex post load impacts using end-use battery data and premise data

2) How do impacts using the end-use battery data compare with impacts at the household level?

3) Do the event calls lead to changes in consumption at the household level?

a. Is there an increase in a household's net discharge to the grid during an event?

b. Do residential batteries export to the grid during emergency events? Or are they used solely to offset the household's energy use?

4) What was the performance when consecutive events were called?

5) What is the full export (to the home and to the grid) capability?

6) What are the pros and cons of settlement of load impacts at the device (battery) level vs. premise meter level?

7) What is the customer experience when participating in this type of study?

8) How does the EM&V analysis compare with the settlement results?

2. Collaboration

The DRET team collaborated with the internal Distributed Generation team and the Integrated Grid Planning and Innovation Team to implement this study. PG&E hired a consultant to manage the EM&V for this DRET study and a third-party program administrator to support dispatch and calculation of customer compensation.

3. Results/Status

- Total number of customers enrolled with PGE VPP - 1367 Customers
- Total number of enrolled PGE VPP batteries - 2,506 batteries
- Total aggregate delivered MWh – 8.92 MWh
- Total aggregate delivered MW (1st hour) – 4.5 MW

Research Question	Findings
Do customers enroll in programs that allow the utility to use their battery for grid needs in exchange for payments?	1,300 of the 7,000 (18.6%) customers recruited into the pilot enrolled. All recruitment took place in the Fall of 2021 via push-notification over a compressed timeline. PG&E offered customers an incentive of $1/kWh for energy dispatched over their typical baseline, and customers were allowed to opt out of events.
What are the ex-post load impacts using end-use battery data and premise data?	The incremental impacts are estimated to be ~4.5 kW in hour 1, ~3.0 kW in hour 2, and less than 1 kW in hour 3.
Do the existing dispatch algorithms to deliver a flexible, controllable grid resource?	The current battery dispatch algorithms deliver all of the resources, all at once, until the available energy storage is exhausted. Currently, the algorithms cannot deliver a consistent level of demand reduction over the event, deliver a requested level of output, or sustain the resources over a longer event duration. The battery manufacturer is in the process of modifying its algorithms, so residential battery resources are more flexible and controllable for grid needs.
How do impacts using the end-use battery (sub-meter) data compare with impacts at the household level?	Load impacts estimated using household-level smart meter data were similar to those calculated using battery end-use data, with less than a 1% difference between the impacts on average.
Do the event calls lead to an increase in a household's net discharge to the grid during an event? And exporting of battery resources to the grid?	When dispatched for events, the batteries not only offset the household's energy use, but also exported energy back to the grid. Customers do not noticeably modify their energy use (of other end-uses) when the battery is used to support grid needs.
What was the performance when consecutive events were called?	The batteries delivered consistent dispatch across consecutive event days. However, events were called during mild weather conditions typically with ample sunshine. The dispatch consistency may change if batteries are discharged under more extreme weather conditions.
What is the full export capability?	On average, batteries were able to discharge 4.5 kW during the first hour for a full net export of 3.3 kW. However, this is not necessarily representative of battery export capability during peak system demand as batteries for this pilot were dispatched under moderate weather conditions.

How does the EM&V analysis compare with the settlement results?	For settlement with customers, the baseline usage is calculated as the same hour average over the past 10 days using battery end-use data. Any battery discharge above the baseline was considered the load impact. On aggregate, the impacts calculated using the settlement baselines are comparable to EM&V results, but were 5% higher on average.

4. Next Steps

This assessment ended on December 31st, 2021. PG&E is finalizing the report and it will be posted at the ETCC website in the 2nd quarter of 2022.