ET Summit 2024

Presented by

Virtual Power Plant Project

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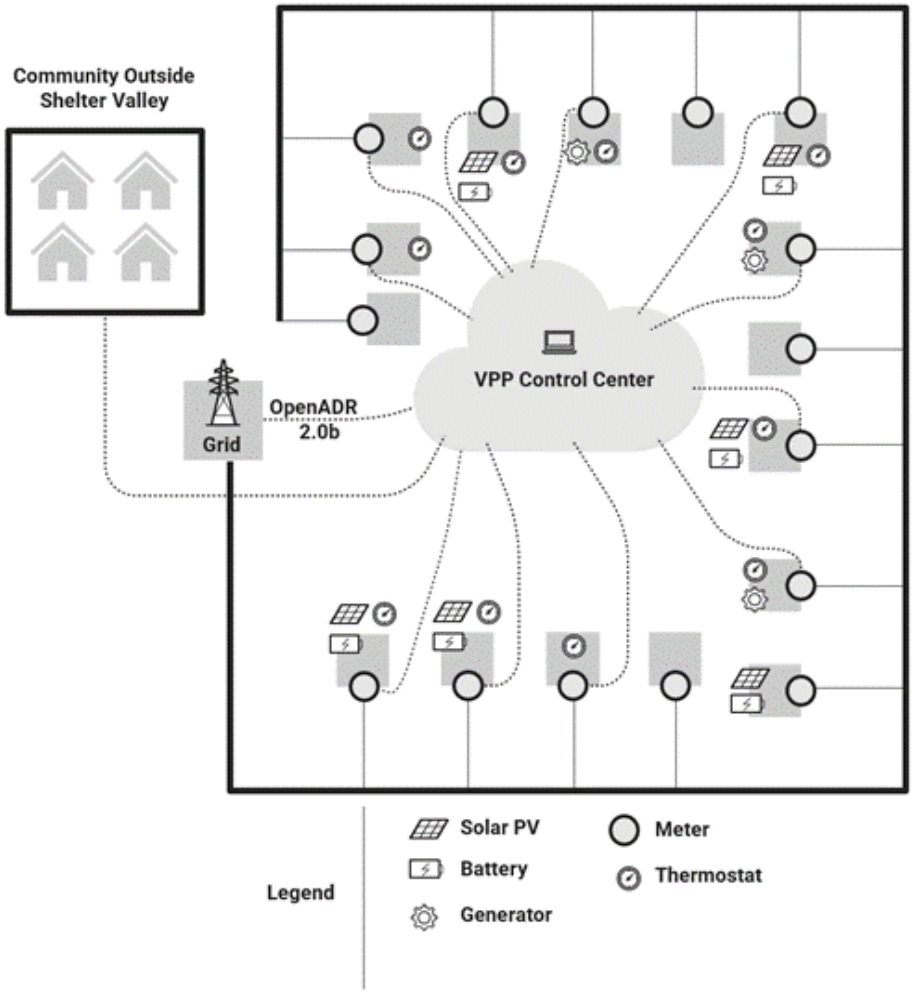
Virtual Power Plant Project Summary

- SDG&E®'s Virtual Power Plant (VPP) project evaluated the control, dispatch, and real-time signaling of behind-the-meter resources installed throughout a vulnerable community in its service territory.

- This project was unique because of its use of multiple end-use devices and different technology providers, including thermostats, well water controllers, water heater controllers and battery storage.

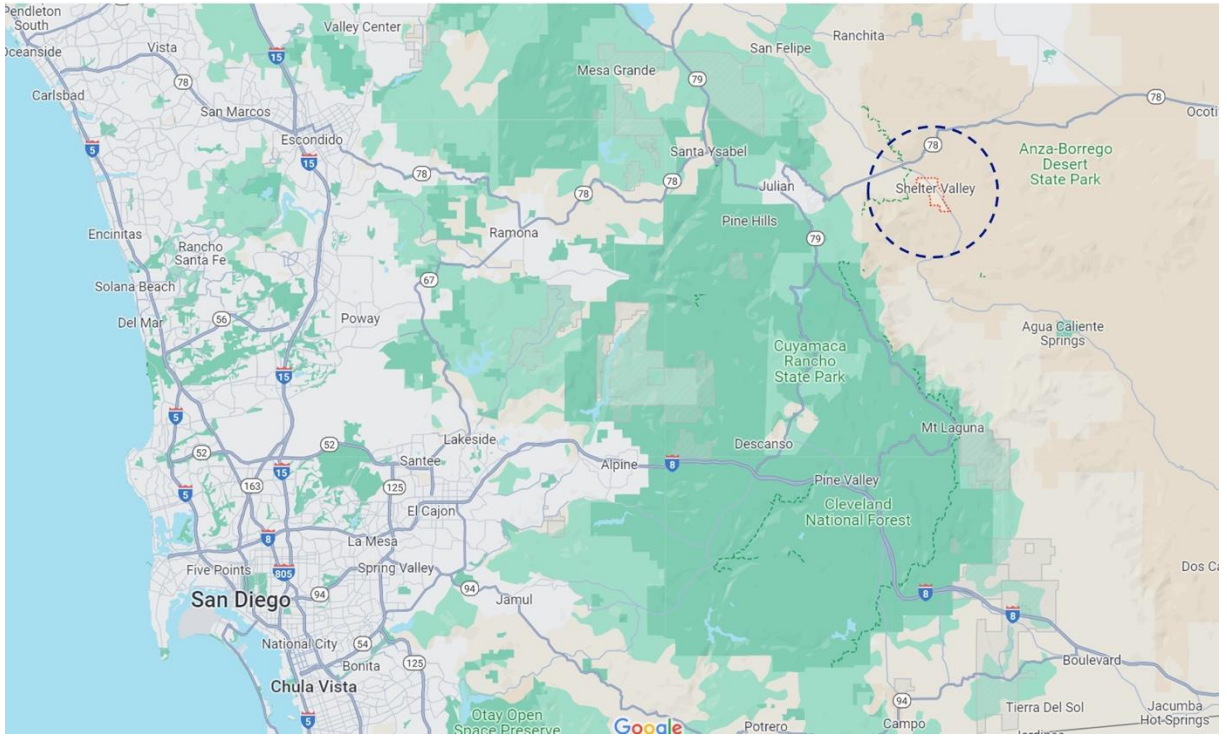
What is a Virtual Power Plant (VPP)?

A VPP is a network of distributed energy resources (DERs) at customer sites all working together as a single “virtual” power plant that can be signaled to provide reliable power during grid needs.



VPP Overview

- **Location:** Shelter Valley, a remote community in East San Diego County that is prone to outages and Public Safety Power Shutoffs (PSPS)
- **Objective:** To strengthen community resilience, electric energy reliability, and emergency preparedness
- **Focus:** Evaluated control, dispatch and real-time signaling of behind-the-meter resources on a single circuit

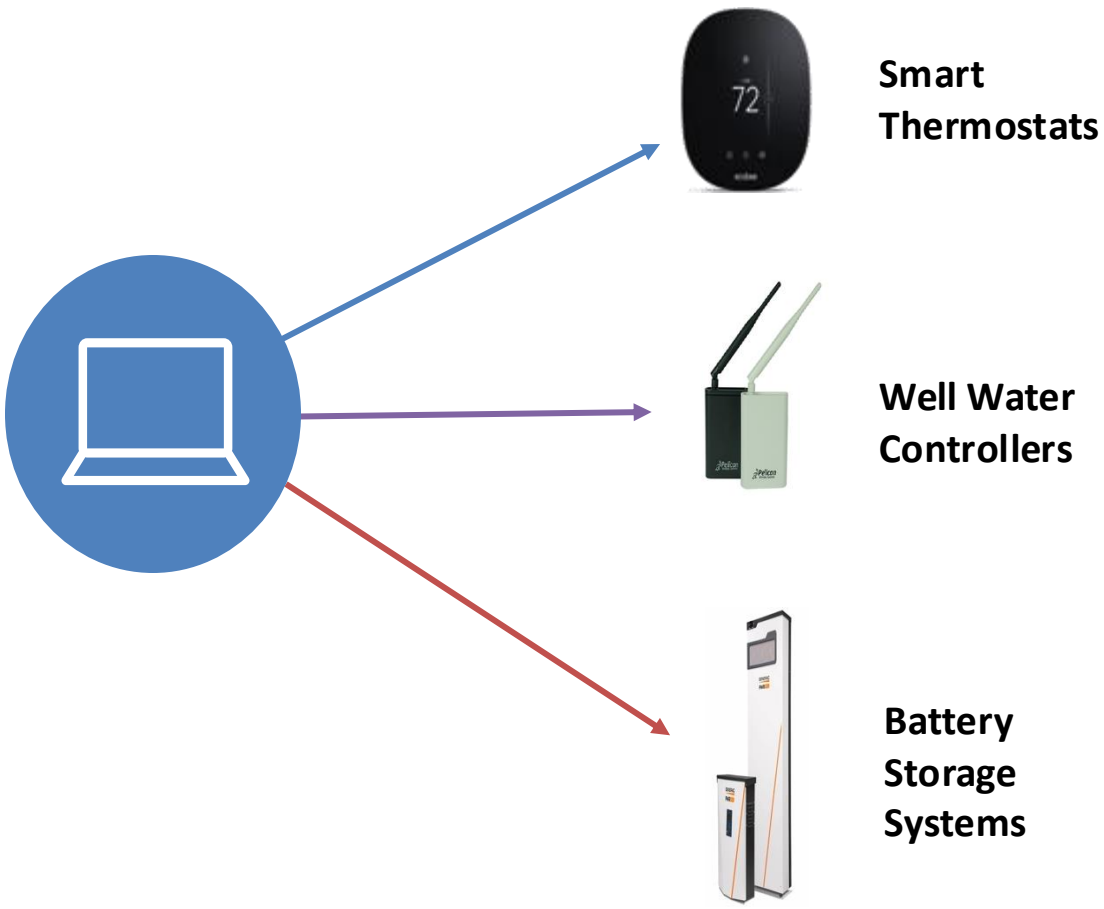


Total Customers
~212

Solar Customers
~40

Source: Google Map

VPP Resource Mix

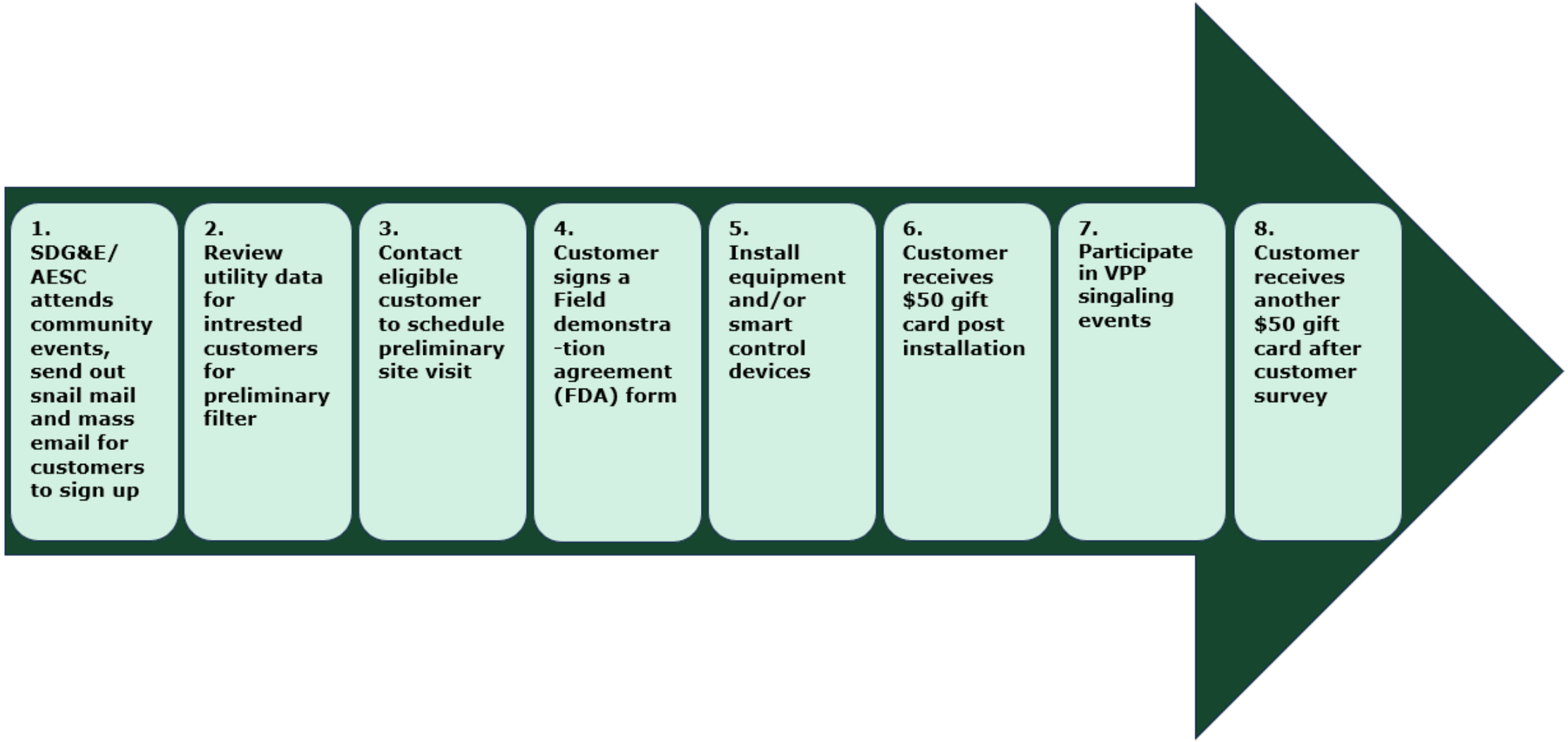


- Multiple end uses and different technology providers
- Resource mix included smart thermostats, well water pump controllers, and 18 kWh battery storage systems
- Central control platform manages cloud-based signaling of devices simultaneously or at pre-defined intervals

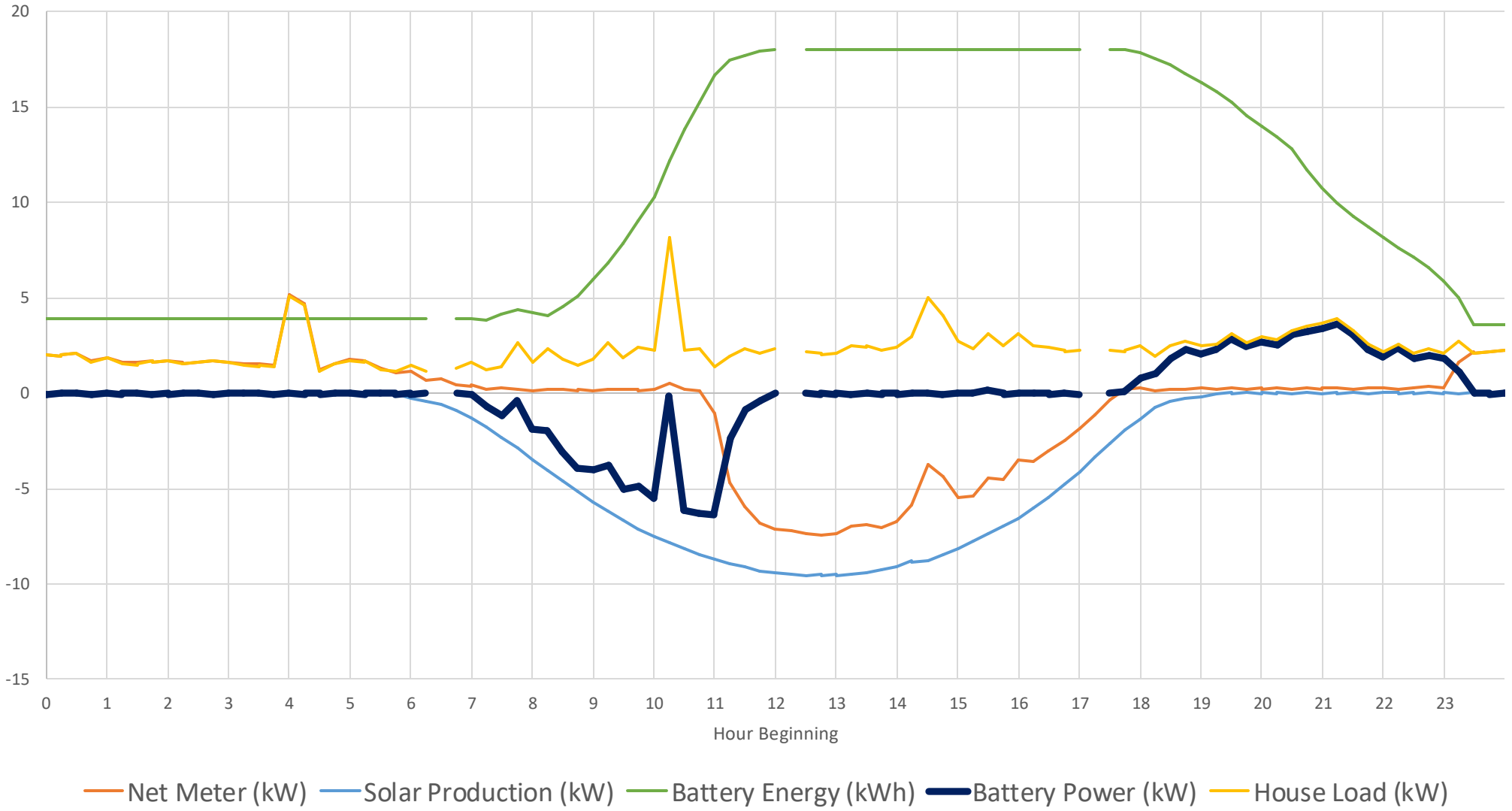
Communications by Technology/Site

Site ID	Participating Equipment	Means of Communication
Site01	Battery	Router/Cell Card
Site02	Battery	Customer Wi-Fi/ Cell Card
	Well pump controller	Customer Wi-Fi
Site03	Battery	Customer Wi-Fi/ Cell Card
	Thermostats (2)	Customer Wi-Fi
Site04	Battery	Customer Wi-Fi/ Cell Card
Site05	Battery	Customer Wi-Fi/ Cell Card
Site06_Community Facility	Battery (2)	Cell Card
	Well pump controller	Customer Wi-Fi
Site07	Well pump controller	Customer Wi-Fi
	Thermostat	Customer Wi-Fi
Site08	Thermostat	Router / Cradlepoint
	Well pump controller	Router / Cradlepoint
Site09	Well pump controller	Customer Wi-Fi

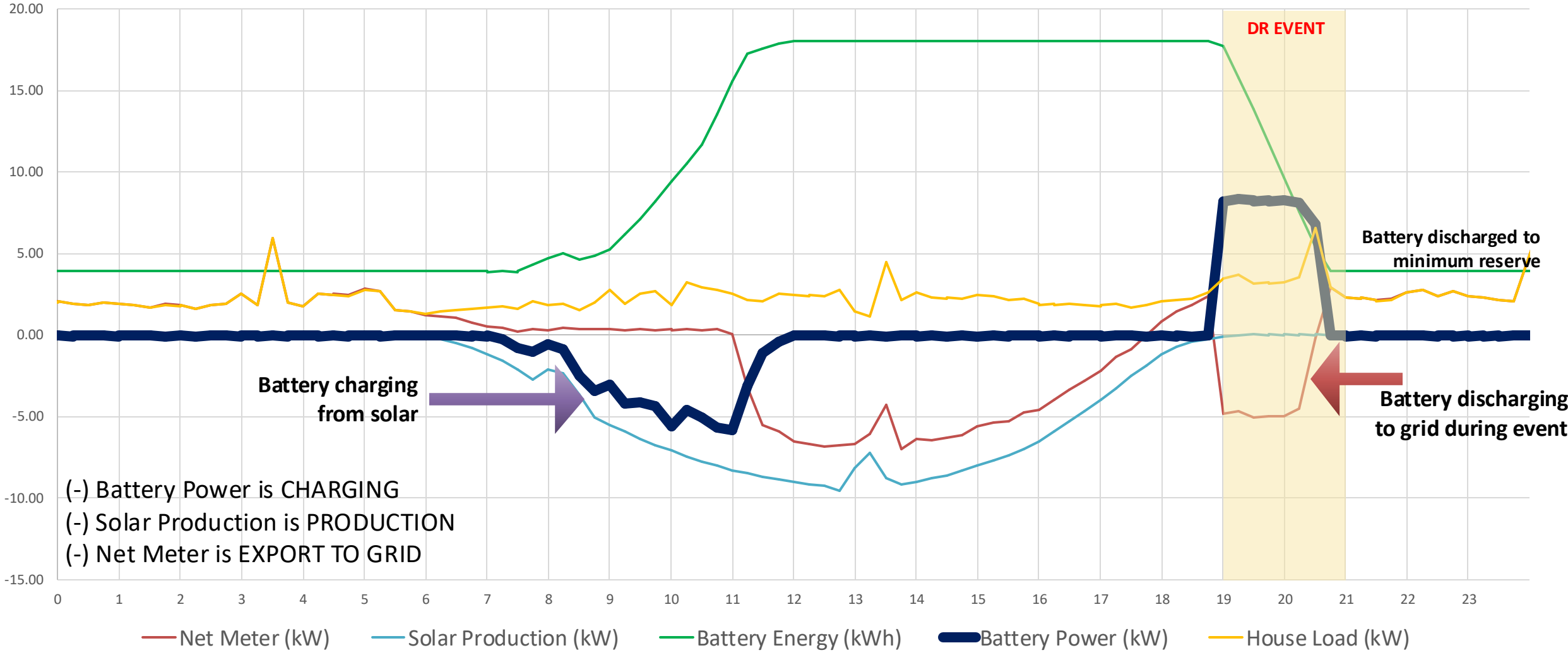
VPP Project Journey



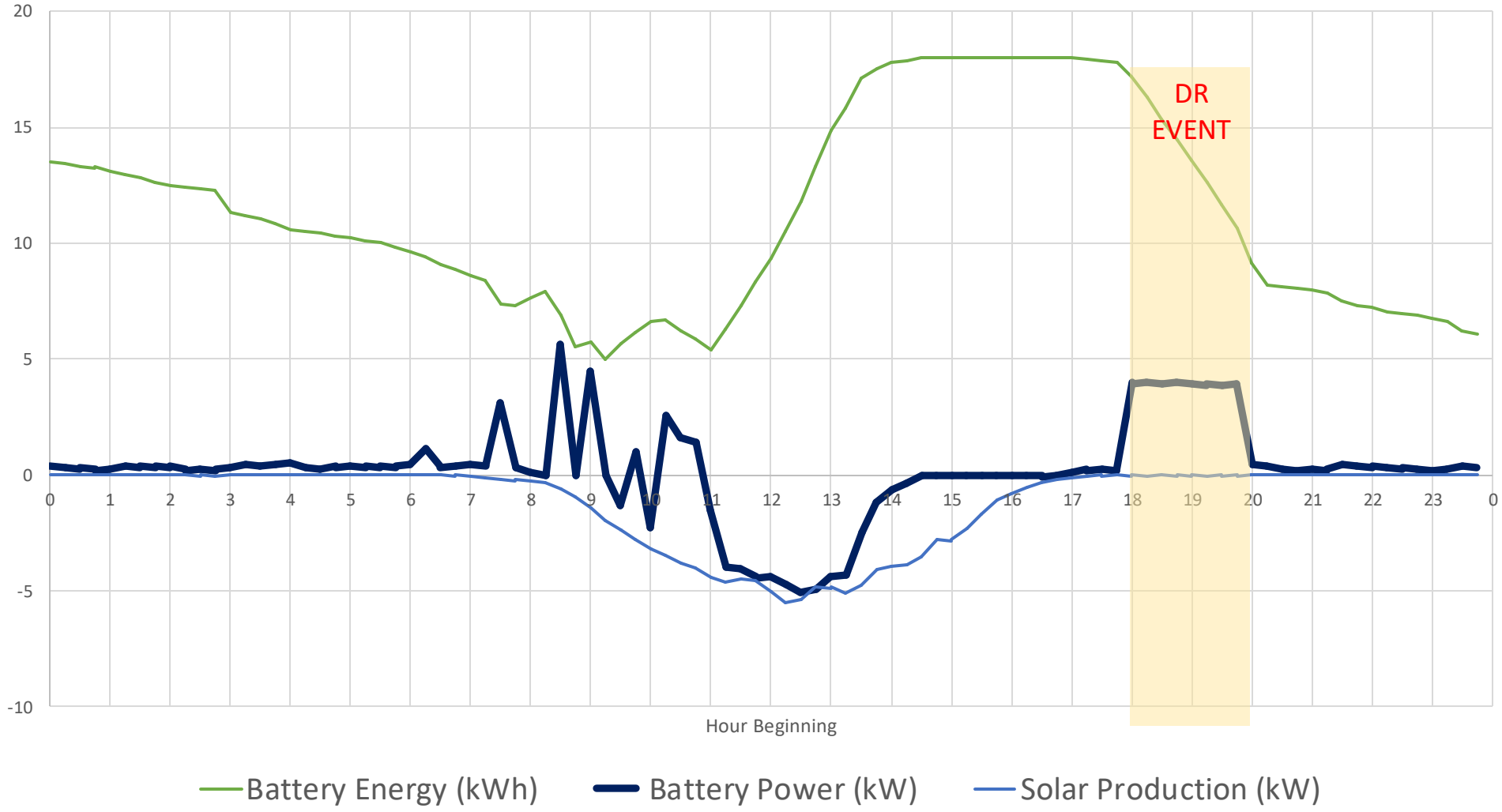
VPP Sample Site Non-Event Day



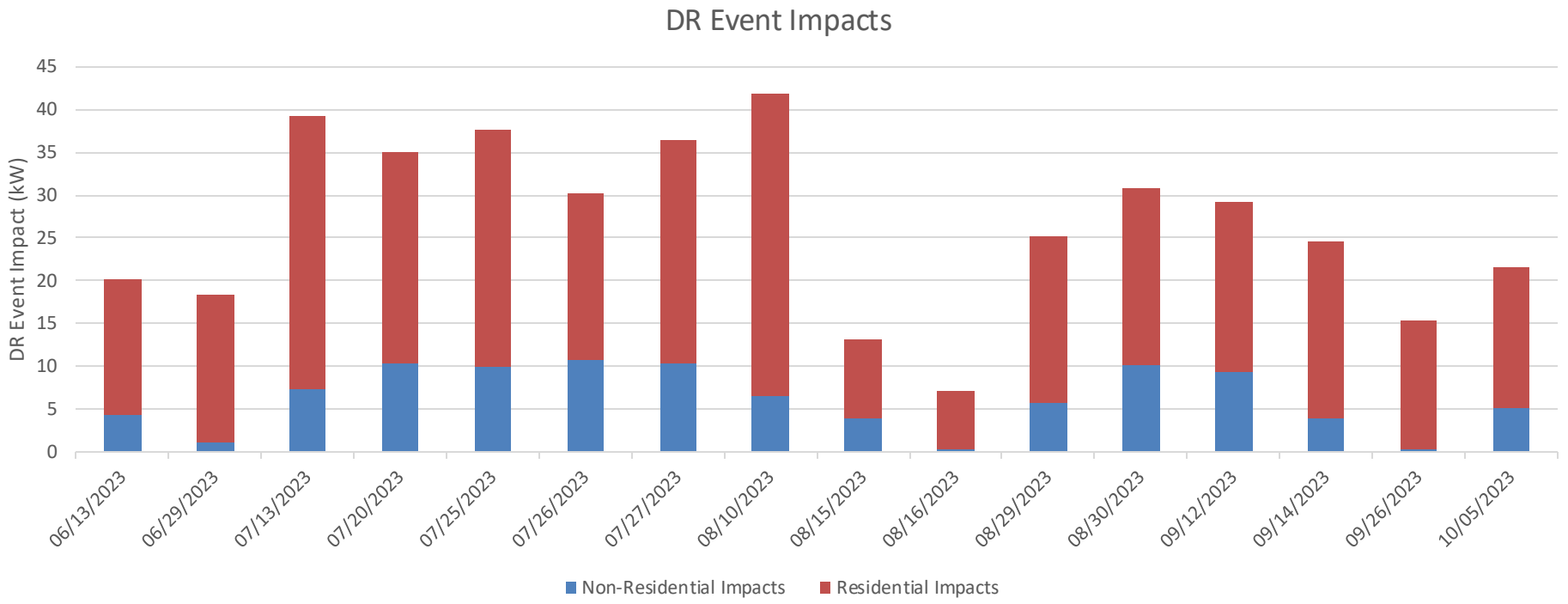
VPP Sample Site - Event Day Performance



VPP Sample Site – Sustained Event Example



VPP Net Meter Impacts



	Average Residential Baseline Load (kW)	Average Residential Demand Reduction (kW)	Average Non-residential baseline load (kW)	Average Non-residential Demand Reduction (kW)	Average Combined Baseline Load (kW)	Average Combined Demand Reduction (kW)
2-Hour DR Events	13.5	22.2	0.4	6.8	13.9	29.0
4-Hour DR Events	7.8	8.0	0.6	2.1	8.4	10.1

Net Meter Baseline

Residential

- 5 highest energy usage days within the 10 eligible weekdays immediately preceding the DR event.
- Adjustment hours were defined as two pre-event hours and two post-event hours, each with a two-hour buffer from the event.
- The Adjustment Ratio was capped at 1.4 (up) and 1/1.4 (down)

Non-Residential

- 10 highest energy usage days within the 10 eligible weekdays immediately preceding the DR event.
- Adjustment hours were defined as three hours prior to the event period with a one-hour buffer.
- The Adjustment Ratio was capped at 1.2 (up) and 0.8 (down).

Battery Equipment: DR Event Signaling Summary

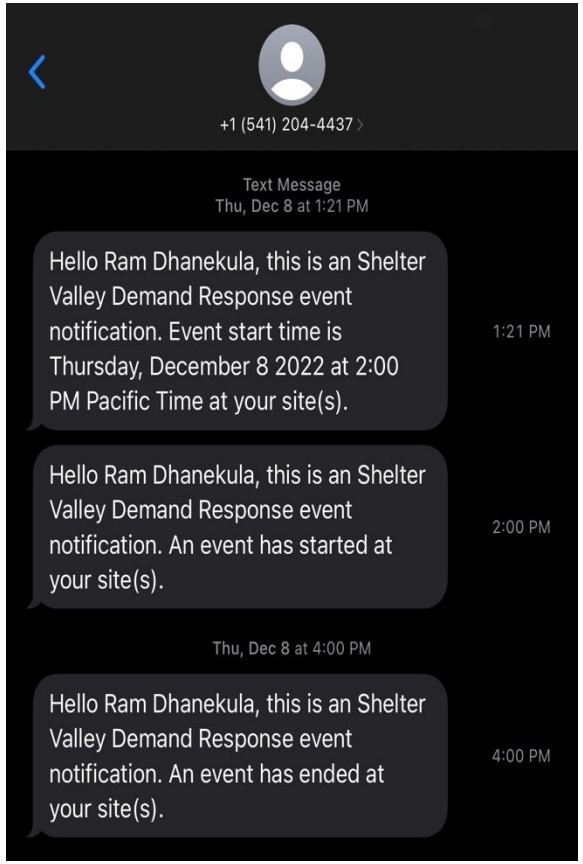
SITE ID	SITE 01	SITE 02	SITE 03	SITE 04	SITE 05	SITE 06 COMMUNITY CENTER
EQUIPMENT SIGNALED	BATTERY	BATTERY	BATTERY	BATTERY	BATTERY	BATTERIES (2)
6/13/2023 7:00 PM	Invalid Configuration*	100%	Connectivity Error	100%	100%	1/2 Batteries Offline
6/29/2023 4:00 PM	100%	Connectivity Error	Connectivity Error	100%	100%	1/2 Batteries Offline
7/13/2023 5:00 PM	100%	100%	Connectivity Error	100%	100%	100%
7/20/2023 7:00 PM	100%	40%	Connectivity Error	100%	60%	100%
7/25/2023 7:00 PM	100%	60%	Connectivity Error	100%	80%	100%
7/26/2023 7:00 PM	100%	50%	Connectivity Error	100%	72%	100%
7/27/2023 7:00 PM	100%	40%	Connectivity Error	100%	72%	100%
8/10/2023 5:00 PM	100%	100%	100%	100%	100%	100%
8/15/2023 5:00 PM	94%	88%	94%	100%	88%	97%
8/16/2023 5:00 PM	94%	66%	100%	100%	66%	1/2 Batteries Offline
8/29/2023 6:00 PM	Connectivity Error	Connectivity Error	100%	100%	100%	1/2 Batteries Offline
8/30/2023 6:00 PM	Connectivity Error	Connectivity Error	100%	100%	100%	100%
9/12/2023 6:00 PM	Connectivity Error	Connectivity Error	Connectivity Error	100%	100%	100%
9/14/2023 5:00 PM	100%	Connectivity Error	Connectivity Error	100%	100%	1/2 Batteries Offline
9/26/2023 6:00 PM	88%	Connectivity Error	Connectivity Error	100%	100%	Connectivity Error
10/5/2023 6:00 PM	88%	Connectivity Error	Connectivity Error	100%	100%	1/2 Batteries Offline

Thermostat: DR Event Signaling Summary

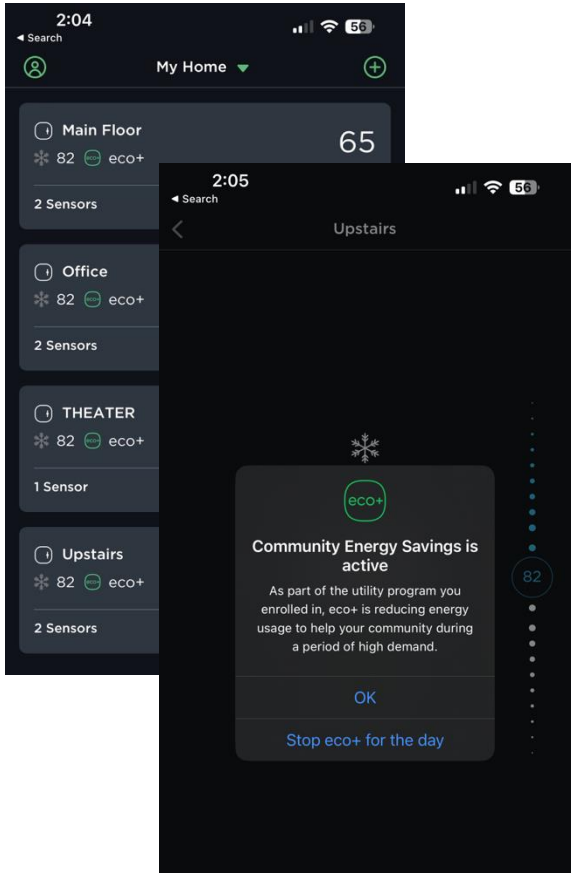
Event Start	Site 03 Thermostats (2)	Site 07 Thermostat	Site 08 Thermostat
6/13/2023 7:00 PM	1/2 overridden	Success	Connectivity Error
6/29/2023 4:00 PM	2/2 overridden	Success	Connectivity Error
7/13/2023 5:00 PM	1/2 overridden	Success	Connectivity Error
7/20/2023 7:00 PM	1/2 overridden	Success	Connectivity Error
7/25/2023 7:00 PM	1/2 overridden	Success	Connectivity Error
7/26/2023 7:00 PM	Success	Success	Connectivity Error
7/27/2023 7:00 PM	2/2 overridden	Success	Success
8/10/2023 5:00 PM	2/2 overridden	Success	Success
8/15/2023 5:00 PM	2/2 overridden	Connectivity Error	Success
8/16/2023 5:00 PM	2/2 overridden	Connectivity Error	Success
8/29/2023 6:00 PM	2/2 overridden	Overridden	Success
8/30/2023 6:00 PM	1/2 overridden	Success	Success
9/12/2023 6:00 PM	1/2 overridden	Success	Connectivity Error
9/14/2023 5:00 PM	Success	Success	Connectivity Error
9/26/2023 6:00 PM	Success	Success	Connectivity Error
10/5/2023 6:00 PM	Success	Success	Connectivity Error

VPP Event Notifications

Text (SMS) Messages



Thermostat Notification



Signaling Platform

- The VPP was implemented using Generac's Concerto platform (https://www.generacgs.com/concerto/).
- When DR events were executed, the platform provided information regarding any opt outs, as well as the time series power data for each event.

VPP Learnings & Experience

- Central platform successfully signaled devices
- Up to 57 kW discharged to grid during each event
- Communication with devices and customer engagement were critical to success
- Assess connectivity
- Modified resource mix (ex. water heater controllers) due to connection issues
- Some customer reservations about utility control of devices
- Consider solar warranties
- Plan for solar monitoring
- Set solar size thresholds

VPP Learnings & Experience

- Device communication challenges (Wi-Fi/cellular issues, device resets, geographic limitations, rodents)
- Emphasize connectivity responsibility
- Frequent battery hardware issues
- Initial opt-outs limited to thermostats
- 25+ VPP events scheduled (events were simulated prior to start of DR season; most events aligned with DR events)
- Robust data collection for comprehensive analysis (solar generation, battery charging/discharging, household demand in addition to net meter)
- Streamline customer agreements
- Diversify outreach channels

Customer Insights

- Customers with battery appreciated the supply of power to their home for few hours during outage and contributing to a reduction in their utility bills.

- Customer with thermostat said it's very user friendly, different settings, more functionality and shows current time on display. Customer said outside air temperature isn't accurate on the thermostat display.

- One customer expressed dissatisfaction with the placement of the battery at the front of her house. However, she understands that there might not have been any alternative options for installation.

- The majority of customers expressed their satisfaction with the battery installation.

- All customers decided to keep equipment installed at their sites.

- A customer has expressed interest in learning about the findings and results of this project.

- "We can use this equipment to maintain a place for people if the power goes off and keep the facility cool and hope we can provide food if needed for our community residents" -Community Leadership

Customer Insights

	Very dissatisfied	Somewhat dissatisfied	Somewhat satisfied	Very satisfied	Not sure	NA
Application / signup process	-	-	13%	75%	-	13%
Installation process	-	-	12%	88%	-	-
Contractor/ Installation Technician	-	-	-	100%	-	-
Your new battery	-	-	-	100%	-	-
Your new thermostat	-	-	-	100%	-	-
Your well pump controller	-	50%	25%	25%	-	-
Your control over the equipment during demand response (DR) signaling events (e.g., opt out)	-	13%	-	86%	-	-
Communication with SDG&E	-	-	25%	75%	-	-
Customer Service	-	-	-	100%	-	-

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For more information, contact Jeff Barnes at jbarnes@sdge.com.

The project report can be found at
https://etcc-ca.com/reports/virtual-power-plant-project

Related Links

Media Release: https://sdgetoday.com/news/sdge-pioneers-virtual-power-plant-help-ease-strain-power-grid-during-extreme-heat

VPP Web Page: sdge.com/vpp

Virtual Power Plants, Explained: https://sdgetoday.com/news/energy-101-virtual-power-plants-explained

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