Hawai‘i Natural Energy Institute Research Highlights

Grid Integration

Hawai‘i Virtual Power Plant (Hi-VPP) Demonstration

OBJECTIVE AND SIGNIFICANCE: HNEI Grid***START*** developed the Hawai‘i virtual power plant demonstration project (Hi-VPP) to evaluate the economic and operational value of distributed battery and solar (BESS + PV) resources when aggregated as a virtual power plant (VPP). The project’s primary aim is to optimize these assets for both customer benefit and grid support, offering insight into reducing electricity costs and advancing demand response strategies for Hawai‘i.

BACKGROUND: Following the completion of the JUMPSmart Maui (JSM) smart grid project, HNEI acquired Sunverge Solar Integration System (SIS) BESS + PV units through an Equipment Transfer Agreement with NEDO of Japan. These assets were installed at Haleakalā Solar’s business office in Kahului, Maui to support field testing and demonstration of multi-scenario VPP operations using real, behind-the-meter energy storage and solar generation resources.

PROJECT STATUS/RESULTS: HNEI developed optimization algorithms that integrate building energy load and rooftop solar power generation forecasts to determine the optimal charging and discharging schedules of BESS units. These algorithms reduce electricity costs for building owners while meeting utility-initiated demand response requirements. A methodology (Figure 1) was also created to evaluate potential customer participation benefits under Hawaiian Electric Company’s VPP program, which uses an incentive-based demand response scheme.

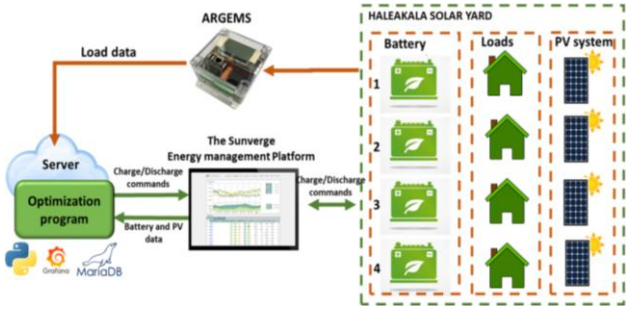

Figure 1. System overview of the methodology.

Building on results and data from the completed field demonstration, Grid***START*** further developed and validated Python-based economic optimization and sizing algorithms that integrate recent demand response programs, such as the “Bring Your Own Device” (BYOD) and Power Partnership offerings, with one year of simulated and measured load and PV data. Algorithm improvements addressed both economic dispatch and optimal system sizing for customers considering VPP participation, evaluating cost-minimizing operational strategies under time-of-use and incentive-rate scenarios.

A Python-based graphical user interface (GUI) has been created to allow prospective VPP participants to estimate the optimal configuration and size of PV and battery systems and assess the financial benefits of VPP participation. The modeling tool, designed to reflect the latest utility program rules, provide actionable insights for participants and utilities aiming to expand VPP adoption and grid flexibility.

Figure 2. User interface for optimal sizing of residential solar PV and battery storage system.

Over the course of the project, the field testing validated optimization methods for integrating building loads, PV generation, and BESS operations across typical and demand response event scenarios. System performance, customer utility cost outcomes and technical functionality were all assessed using live monitoring and control platforms. The field demonstration activities and all field site operations concluded with the completed decommissioning and removal of equipment in early 2025, marking the formal close-out of on-site experimental work.

Funding Source: Office of Naval Research; U.S. Department of Energy

Contact: Leon Roose, lroose@hawaii.edu

Last Updated: November 2025