Hawaiʻi Natural Energy Institute Research Highlights

Grid Integration

Granular Hosting Capacity Methods

OBJECTIVE AND SIGNIFICANCE: HNEI's Grid System Technologies Advanced Research Team (Grid***START***) explored ways to increase distributed photovoltaic (DPV) penetration, specifically for feeders that are reaching their hosting limits. This project assessed a granular hosting capacity (HC) methodology that assigned HC limits to individual service transformers and assessed the benefits of inverter volt-var controls to show the potential for DPV expansion without major grid upgrades.

BACKGROUND: Hawaiian Electric (HECO) currently determines DPV HC at the primary feeder level by aggregating all loads and PV at the service transformer and evaluating only the primary distribution voltage. While effective for broad assessment, this approach can obscure available capacity and restrict new DPV projects as feeder limits are reached.

PROJECT STATUS/RESULTS: Key limitations addressed by included:

1. Feeder-wide HC limits allow "bad actor" transformers with low HC to effectively reduce capacity for other transformers with higher HC;
2. Fixed secondary voltage drop assumptions (typically 2.5%) do not reflect actual variations, potentially limiting or overestimating hosting space; and
3. Aggregation prevents accurate modeling of volt-var response for DPV inverters, now required for new PV systems in Hawaiʻi.

This study used HNEI's Maui Meadows feeder model, detailing the low-voltage "secondary" networks down to the customer level. The granular method assigned HC limits to each transformer, avoiding low HC transformers from limiting the HC of other transformers on the feeder. Voltage was checked at each customer connection, removing the need for HECO's secondary voltage-drop assumption, and volt-var impacts were evaluated locally. A stochastic framework placed PVs at each customer incrementally to simulate thousands of DPV build-out scenarios and configurations.

Granular HC modeling increased total feeder DPV hosting by 34% (+891 kW) over the HECO-defined baseline for Maui Meadows, supporting 3,538 kW PV unevenly distributed, vs. the feeder-level cap of 2,647 kW. Adding volt-var controls for new PV systems raised HC an additional 3%. If all PV systems, including those of legacy net energy metering (NEM) customers, were volt-var capable, total capacity would rise by an additional 6%. The proposed granular method can safely unlock more DPV integration without any physical infrastructure changes, though detailed secondary modeling remains resource-intensive and is not readily available. Utilities could focus secondary-level models on high-value or near-limit feeders.

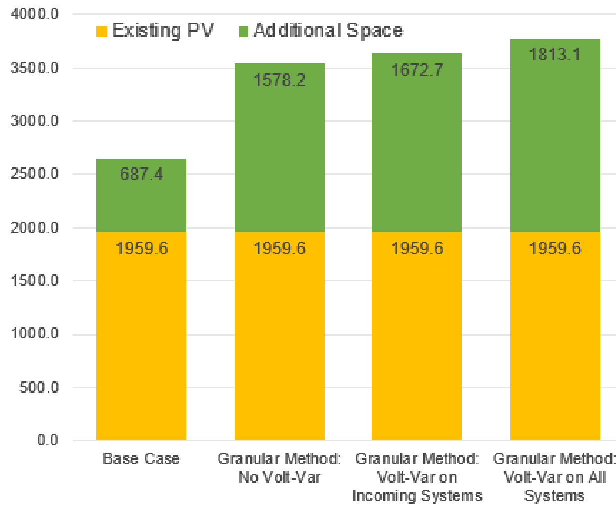

Figure 1. Summary of HC growth (in kW) with advanced modeling methods.

Nearly half of HECO's existing DPV capacity was installed under the original full-retail NEM program. On Oʻahu, these NEM subsidies currently cost non-NEM customers approximately $70 million per year more than if NEM customers were billed under the current DER program. Transitioning NEM customers to a revised DER structure could free up those funds to expand DER HC. However, there is currently no plan to transition NEM agreements to the current program, and such a transition may face significant legal scrutiny, as seen in other jurisdictions.

Additional analysis to incorporate the value of local batteries has been initiated. Preliminary results indicate that storage combined with DER can further increase hosing capacity, by significant amounts. This work is continuing.

Funding Source: State of Hawaiʻi

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Last Updated: November 2025

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