# Hawaiʻi Natural Energy Institute Research Highlights

*Energy Policy & Analysis*

## *Maui Reliability and Kahului Retirement Analysis*

**OBJECTIVE AND SIGNIFICANCE**: The Kahului Power Plant (KPP), one the oldest steam oil plants on Maui, is scheduled to retire by the end of 2024. This retirement has been proposed for over a decade but has been delayed due to projected system reliability challenges. The objective of this study was to evaluate the ability of proposed utility scale solar + storage resources to maintain grid reliability when KPP is retired. The results of this analysis were briefed to the Hawaiʻi Public Utility Commission (PUC) and other stakeholders and are expected to have important implications for power system planning and policy for Maui.

**KEY RESULTS**: Stochastic analysis, using the tools developed by the HNEI-Telos Energy team that have previously been used to evaluate resource adequacy of the Oʻahu grid, was conducted. It was found that the KPP retirement without deployment of other generation sources would significantly reduce system resource adequacy as measured as loss of load expectation (LOLE). However, the analysis showed that deployment of even a small portion of the proposed hybrid solar + storage projects would improve system reliability compared to current reliability levels. Full deployment of proposed Stage 1 and Stage 2 solar + storage resources would significantly improve system resource adequacy compared to current operations.

The number and size of proposed replacement projects, the retirement timeline, and the ability to extend KPP operation, if necessary, makes the reliability risk on Maui significantly lower than that associated with the Oʻahu coal retirement plans.

**BACKGROUND**: KPP is a 36 MW steam oil power plant located in Kahului, Maui. It is comprised of four separate steam oil generators and is over 72 years old. Maui Electric Company (MECO) has frequently proposed retirement of the plant over the past decade, but had not been able to develop and procure replacement resources due to project delays and regulatory limitations. Currently, there is a proposed transition plan by the utility comprising deployment of utility scale solar + storage hybrid resources and upgrades to the transmission system. According to Hawaiian Electric:

"The KPP Transition Plan has several key components: (1) the Stage 1 and Stage 2 RFP projects will provide capacity and energy replacement and grid services; (2) the K3 and K4 generating units of KPP will be converted and repurposed to synchronous condensers to replace critical voltage support service and synchronous inertial response provided by KPP, among other essential grid services; (3) the Waena Switchyard project will maintain functionality and reliability of the transmission system serving Maui in the absence of KPP, avoid circuit overloads, and reliably integrate new renewable resources; and (4) contingency plans that include DER grid service programs and a review of generator maintenance schedules as needed."[1]

Once complete, the Stage 1 and Stage 2 projects will significantly change the Maui system. The projects constitute 135 MW of solar with 540 MWh of storage along with a 40 MW, 160 MWh standalone battery in Waena. Projects are anticipated to come online between 2022 and 2023. Once complete, the Maui system will approach 100% RPS (as a percentage of sales) and 75% annual energy (as a percentage of total generation) from renewable resources. Expected annual energy generation based on RPS is shown in Figure 1.

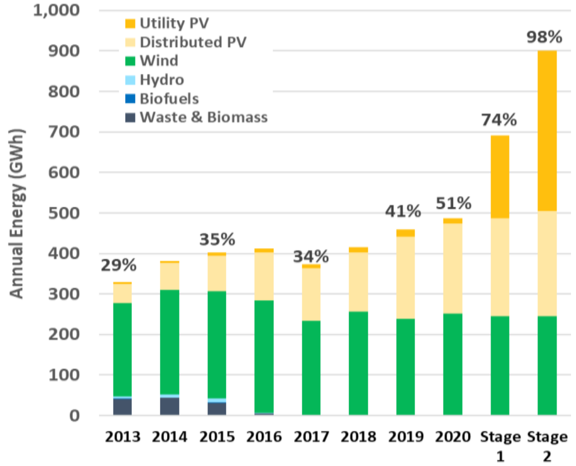


Figure 1. Maui Renewable Growth and RPS (%) by Year.

**PROJECT STATUS/RESULTS**: To assess the reliability (specifically resource adequacy) of the Maui system

[1] Hawaiian Electric Company, Kahului Power Plant Transition Plan, Docket No. 2021-0024, April 5, 2021, https://dms.puc.hawaii.gov/dms/DocumentViewer?pid=A1001001A21D06A91020A00146

with the KPP retirement and replacement solely with variable renewable energy and energy storage, HNEI and Telos Energy utilized its sequential Monte Carlo probabilistic modeling, which incorporated 22 years of chronological solar data, 8 years of chronological wind data, and 12 years of historical outage data for the thermal generators. This is the same probabilistic methodology used to evaluate the AES coal plant retirement on Oʻahu).

Grid simulations were conducted across four scenarios with assumptions on load, DER integration, and other system details derived from HECO's Integrated Grid Planning assumptions for the year 2024. The Reference Point scenario assumed the current grid's resource mix, including KPP, without additional retirements or new solar resources. Three additional scenarios were evaluated: 1) with KPP retired without replacement, 2) with 75 MW Stage 1 resources, and 3) with another 60 MW of solar + storage and 40MW of standalone storage resources with the Stage 2 portfolio. Each of these scenarios are illustrated in Figure 2.

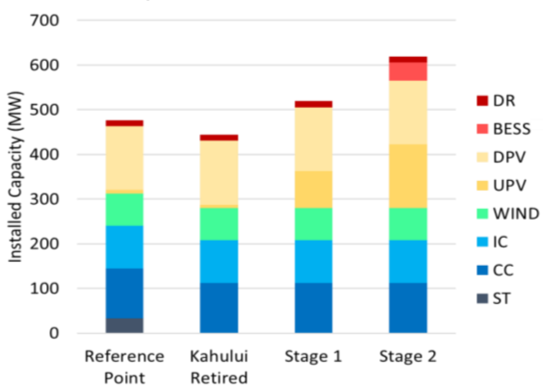


Figure 2. Installed Capacity by Scenario.

Each scenario was analyzed across 440 random samples (replications) of chronological dispatch, representing 22 years of solar data, 8 years of wind data, and 20 outage profiles per weather year (440 total). The output of the analysis included the number, the magnitude, and the duration of the capacity shortfall events that occur when there are not enough available resources to serve load.

Results of the analysis are provided in Figure 3 with the same data shown on both figures with the exception of the y-axis (normal vs. log axis respectively). These results indicate that any combination of ~40 MW of solar + storage or standalone storage resources brings the system back to its current level of reliability.

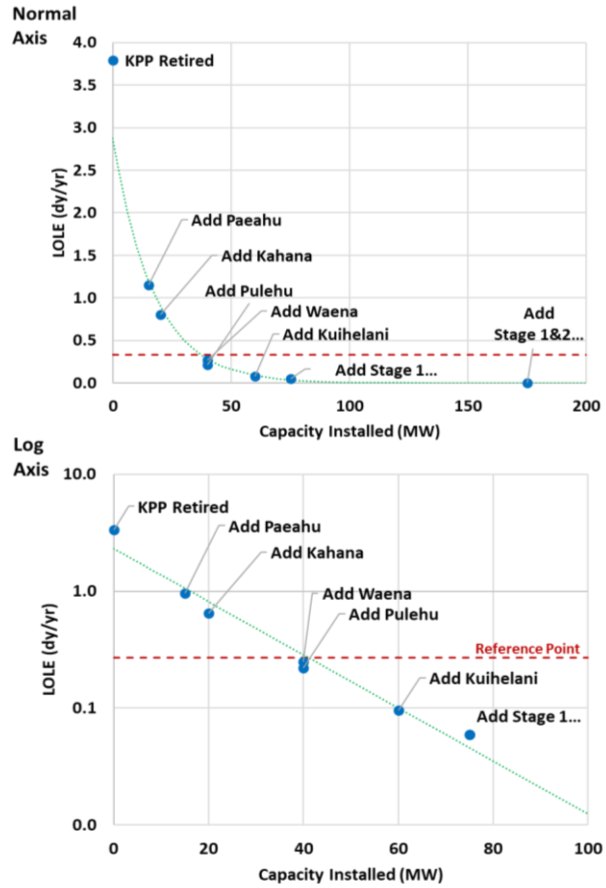


Figure 3. System LOLE at Increasing Levels of Solar + Storage.

Full deployment of Stage 1 and 2 resources eliminates all loss of load events in the resource adequacy simulations, indicating a much higher level or reliability relative to historical norms and a potential opportunity for additional retirement of fossil unit. The results also highlight an important finding, consistent with the results for Oʻahu, that solar and storage resources provide a near 1-to-1 replacement capability relative to thermal capacity on the system. While this relationship will not continue indefinitely, it highlights the ability for variable renewables and energy limited resources to provide firm capacity.


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