Hawai‘i Natural Energy Institute Research Highlights

Grid Integration

Recent Reliability Challenges

OBJECTIVE AND SIGNIFICANCE: HNEI regularly monitors grid operations and hourly generation data provided in PUC dockets and provides independent reviews of reliability events. Recently, the Hawai‘i’s power grids have faced some reliability challenges (resource adequacy). An assessment of the most recent events indicates that the transition to renewable energy is not to blame. Rather, higher than normal failures at oil-fired power plants have challenged grid reliability on O‘ahu and Hawai’i Island. The new solar and storage systems are emerging as valuable assets for maintaining reliability.

KEY RESULTS: Recent reliability events on O‘ahu occurred during a period of cloudy weather with low solar and wind generation, but the lower than usual energy available from renewables was not the cause. Instead, the rolling blackouts were due to unexpected outages of several of the utility’s oil-fired generating plants at a time when several other generators were offline for maintenance. In July 2024, the utility asked for conservation due to higher than usual risk of a generation shortfall due, again, to an unexpected loss of generation. However, during this, the new solar and storage resources played a crucial role in supporting grid reliability.

BACKGROUND: In the early winter and spring, the electric grids on O‘ahu and Hawai‘i Island experienced rolling blackouts. These rolling blackouts occurred because of island-wide generation supply shortages. Simply stated, there was not enough generation or stored energy available on the island to serve the demand. This occurred four times recently: once on O‘ahu (January 8th) and three times on Hawai‘i Island (January 30th, February 13th, and April 15).

More recently, the O‘ahu power grid had another close call on July 31st when calls for conservation were initiated by the utility due to anticipated energy and capacity shortfalls. However, rolling blackouts were avoided and customers were not impacted due to the availability of energy from the batteries.

These types of reliability events, referred to in the power industry as resource adequacy shortfalls, are exceedingly rare on the mainland, where grids are larger and more interconnected. While still rare in Hawai‘i, they do occur more often because the island’s grids are smaller and isolated from neighbors. On O‘ahu, for example, planners design to expect no more than one shortfall every four years.

PROJECT STATUS/RESULTS: Over the past year, HNEI has been analyzing utility operating data, including hourly load and generation by power plants. The project team tracks generator performance, outage rates, maintenance schedules, and operating reserves.

This analysis revealed that while the January 8th outages on O‘ahu occurred during a period of cloudy weather with low solar and wind generation, the availability of energy from the variable renewables was not the cause. Instead, the rolling blackouts were triggered by unexpected outages of several of two of the utility’s oil-fired generating plants, at a time when others were offline for maintenance. During this event, Hawaiian Electric Company (HECO) lost significant generation capacity in quick succession due to flooding at the Waiau power plant and failures at the H-Power waste-to-energy plant.

The July 31st reliability event was caused by sequential generator outages over a period of days at HECO’s three largest power plants. This sequence of events is discussed in more detail below.

Whether due to age alone or a combination of other factors, the utility’s generators are facing increasing maintenance needs and more frequent mechanical failures. The decreasing reliability of these plants, as measured by how often they become unavailable without warning, is posing a significant challenge to the utility. Figure 1 shows the percentage of firm generation, weighted by capacity, which was on unexpected, forced outage each year since 2007. On O‘ahu, this “weighted forced outage’ rate has increased from below 5% in 2007 to 20% in 2023.

On July 31st, the day of the most recent call for conservation on O‘ahu, only 700 MW (less than half) of the island’s oil-fired power generation was available. With peak demands reaching up to 1000 MW during the evenings, the grid found itself unable to rely on its usual generation capacity to meet the demand. Figure 2 illustrates the available capacity on O‘ahu from oil-fired generation (gray bars) relative to the hourly load (black line) from July 29th to July 31st.

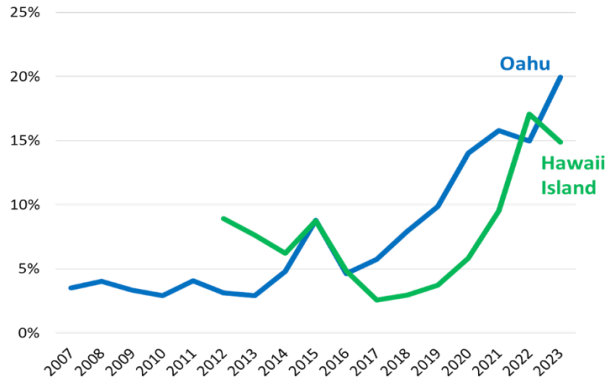

Figure 1. Increasing unavailability of HECO firm generators due to unplanned outages.

Although thermal generation was experiencing unexpected outages, the solar and storage plants performed effectively during critical evening peak demand hours, playing a crucial role in serving the grid's energy needs (Figure 3). Throughout the evening hours, when the oil-fired power plants alone could not meet the demand, these hybrids solar + storage and standalone storage systems provided the necessary power to avoid rolling blackouts.

As more fossil-fueled resources are retired, batteries and renewable energy systems will be increasingly important in ensuring grid reliability. The July 31st event demonstrates that with the right planning and effective operation, renewable energy can not only provide energy to the grid but can also provide essential reliability services during critical times.

HNEI will continue to monitor grid operations and reliability across the Hawai'i power grids and intends to share its findings with the PUC, the utility, the Hawai'i Energy Policy Forum, and the interested public.

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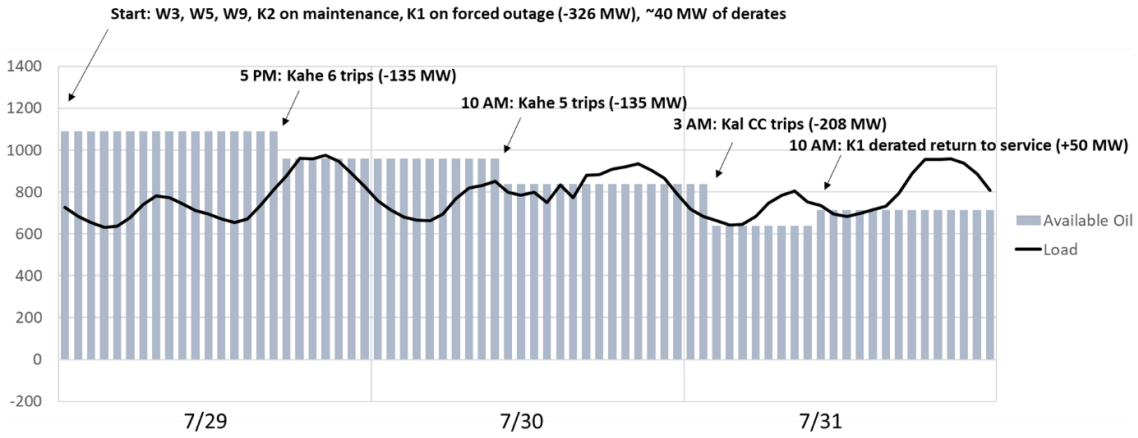

Figure 2. Available capacity from oil-fired power plants declined throughout the week of July 31.

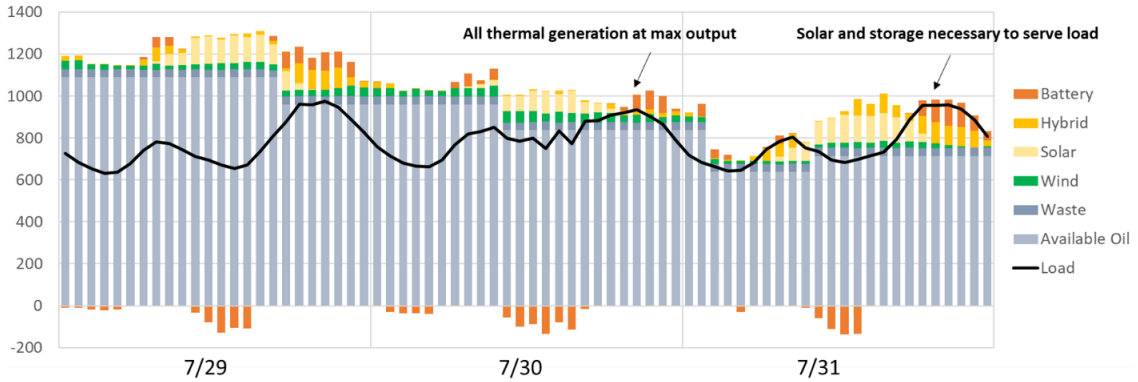

Figure 3. Hybrid and battery resources fill the gap and maintain reliability during critical evening hours.