Tesla Teams With Tiny Hawaiian Utility to Store Solar

By David Wagman
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Tesla

Tesla-supplied lithium-ion batteries are deployed next to a 13 MW solar panel array on the island of Kauai in Hawaii.

A 33,000-member electric power cooperative on the island of Kauai in the Hawaiian archipelago is emerging as a leader as it moves from fossil-based power generation to renewables, and deploys what ranks as one of the world's largest arrays of lithium-ion battery packs.

The battery storage became operational in March and is expected to make solar power produced during the daytime available to customers well into peak demand periods after sunset.

Tesla Motors Inc. (https://www.tesla.com/), in association with Kauai Island Utility Cooperative (http://website.kiuc.coop/content/welcome) (KIUC), deployed the battery storage using a design derived from the Tesla Model S vehicle. The 272 Powerpack energy storage units are sited at a solar farm whose 55,000 photovoltaic panels have a generating capacity of 13 megawatts (MW).

Under terms of the deal with Tesla, KIUC will buy power for 20 years at the rate of 13.9 cents per kilowatt-hour (KWh). The 52 MWh battery system is design to feed up to 13 MW of electricity onto the grid. Doing so is expected to shave the amount of conventional power generation needed to meet the evening peak, which lasts from 5 p.m. to 10 p.m.

KIUC President and CEO, David Bissellsays the cost is lower than that incurred to buy power from diesel-fueled power plants and is below the charge paid by electricity customers elsewhere in the state.

The solar-plus-battery facility means that KIUC has achieved roughly 44% renewable generation, says Bissell. "This is truly remarkable when you consider that as recently as 2011 we were 92% dependent on fossil fuel generation," primarily diesel and naphtha.

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In an email interview, Bissell said that the primary driver for the move toward renewable energy was the "high/unknown cost of oil, and the fluctuations in price which made it difficult for us to control costs for our members." Another factor was the desire to shrink the cooperative's environmental footprint.

evening.

Storing the Sun

Because of the island location and the abundance of sunshine available, the cooperative experiences almost 100% renewable generation during daylight hours. Its board of directors saw that the only way it could continue to harness solar energy to meet its renewable energy goals was to find a way to store the electricity and use it to meet peak demand periods that occur after sunset.

The cooperative's evening peak is also its highest-cost period of the day. Knowing that, system planners opted to use batteries to shift low-cost solar to that period. A request for proposals in 2014 yielded interest but failed to deliver a price that made sense for members.

Over the course of the year, however, the coop worked with Tesla to refine the project and reduce the power purchase agreement price to 13.9 cents per KWh. Bissell says that is lower than the current price of petroleum-based generation.

Prior to the recent investment in renewable generating resources, Kauai's two main power plants (http://www.nrel.gov/docs/fy12osti/52076.pdf) included the Port Allen and Kapaia Power Station. Port Allen has 12 generators capable of producing 96.5 MW of power. It also has a heat recovery steam generator (HRSG) that uses waste heat from two combustion turbines to produce steam for additional electrical generation.

The Kapaia Power Station includes a 27.5 MW steam-injected gas turbine facility and had been KIUC's more efficient and cleaner-burning plant. The plant provided most of the island's power. The cooperative also maintains the Waiahi hydro power plant, which includes the Upper and Lower Waiahi hydro-electric units, rated at 500 kW and 800 kW, respectively.

Reviving Renewables

Bissell says that during the island's plantation era and into the 1990's, the utility had a significant amount of renewable energy that came from biomass boilers operated by the plantations.

As recently as 2011 the utility depended on fossil fuels for more than 90% of its electricity generation.

By 2008, however, less than 10% of the cooperative's generation mix came from renewable sources. That year, he said, the KIUC Board of Directors adopted a strategic plan that called for the utility to source at least 50% of its power from renewables by 2023.

"It was simply the right thing to do," says Bissell, "knowing that we live on an isolated island with access to abundant renewable resources."

Buoyed by the pace of its renewable generating resource deployment, the cooperative's Board of Directors in January increased the strategic plan target to achieve 70% renewable energy by 2030.

It's a target, Bissell says, that "we have every confidence we will meet."

Renewable energy—and solar in particular—tended to be among the most expensive generating options available to remote places like Kauai. Storage options to smooth out the intermittent nature of wind and solar were also wildly expensive, even for large-scale mainland utilities.

Learning from Remote Areas

Indeed, a 2012 report by the International Energy Agency's Renewable Energy Technology Deployment (http://iea-retd.org/wp-content/uploads/2012/06/IEA-RETD-REMOTE.pdf) group said that with a few exceptions, most of the world's remote areas depend on oil for all of their electricity, heating and cooling, and transportation needs. That can make the economies of remote areas and islands "extremely vulnerable" to oil price volatility and supply disruptions.

The report says that the idea of "remote" can include infrastructure and economy as well as geography. Some of Hawaii's archipelago, for example, are remote both in terms of geography and infrastructure, the report suggests. Parts of sub-Saharan Africa and South America's Amazon region are remote from all three perspectives: infrastructure, geography, and economy.

But remote communities like KIUC also serve as something of a test bed for technologies like battery storage and strategies that focus on integrating renewable energy to the broader grid. Lessons learned from remote areas can teach large-scale electric utilities how to successfully deploy and integrate renewables and storage technologies.

KIUC had to address two challenges: supply intermittency (for example, when clouds pass over solar farms) and lack of firm power (caused by uncertainty over how much power will be generated on any given day).

Supply intermittency is being managed through batteries, governor tuning, and increased spinning reserve, Bissell says. The lack of firm power is managed by not retiring the cooperative's conventional generating units.

Bissell says that KIUC's overall reliability has not been impacted negatively by its increased use of renewables. Instead, he says that since adding solar and biomass generation KIUC has actually experienced better reliability. For the past three years, the cooperative has achieved a reliability factor in excess of 99.9%, Bissell says.

Reliability factors have improved since the shift to renewables began, KIUC says.

The Tesla-supplied batteries are expected to help support that reliability performance record and enable further penetration of renewable generating resources. Tesla says that each Powerpack module contains 16 battery pods, each with an isolated DC-DC converter. Their design is based on batteries used in Tesla's Model S vehicle. A dual coolant and refrigerant loop system, adapted from the Model S, offers what the company says is better efficiency than air cooling.