PROJECTS

New projects pair multiple renewables with storage

Large-scale battery storage is perhaps the most important enabling technology for the next phase of the energy transition – and utilities are taking note. Now, the first projects that pair two or more renewable technologies with storage are coming online, reports *Andrew Williams*.

The Kennedy Energy Park features approximately 55,000 solar panels with a peak output of 15 MW

Photo: Windlab

As part of the ongoing effort to reduce carbon emissions, interest in projects that combine two or more types of renewable energy with battery storage is rising – and a growing number of such initiatives are planned or already operational. So, what renewable energy and storage technology is installed at such facilities? How exactly does each set-up work as a system? What benefits and challenges are related to combined renewable energy generation and storage facilities like this?

Kennedy Energy Park

One of the most advanced existing projects is the Kennedy Energy Park facility – located approximately midway between Townsville and Mount Isa in Australia – a large-scale hybrid generating facility incorporating a wind and solar farm together with battery storage. The project, run by global renewable energy development company Windlab, consists of twelve 200m tall wind turbines with a total generating capacity of 43.2 MW, approximately 55,000 solar panels with a peak output of 15 MW and a 2 MW/4 MWh battery.

While the total generating capacity of the wind and solar components is over 58 MW, the complementary nature of the wind and solar resource means that potential generation is rarely larger than an existing 50 MW grid limit. According to Roger Price, Chief Executive Officer at Windlab, instances of excess generation tend to occur in mid-morning – triggering use of an on-site battery to soak up generation that would otherwise be curtailed.

'By late morning, if the battery isn't already fully charged, the control system will act to charge it,' Price said. 'The stored power is released during the afternoon price peak when price and demand are typically at their highest. The battery is also being used to provide ancillary services to the grid, helping to keep the grid frequency at 50 Hz.'

A single control system operates all elements of the Kennedy Energy Park – and receives signals from hundreds of sensors and monitors across the facility, together with the signals from the electricity market operator and the transmission company. Algorithms within the park controller then determine the most efficient way to dispatch power from the wind, solar and battery components.

Reliability

As Price explained, the broader area for the facility was first identified by Windlab in 2008 as having a very good quality wind resource, and being large enough to host an extremely large wind farm. When a proposed power line to Mount Isa, called CopperString, was put on hold in 2011, Windlab prioritised the first phase of this project in the southern part of the site near Hughenden.

In addition to being very windy, Price revealed that the area also contains some of the best solar resource in Australia, leading Windlab to investigate the potential for the site to host both a wind and solar farm.

Measurements at the site indicated that the wind and solar resources were highly complementary, with the wind strongest during the night and weakest during the middle of the day – diametrically opposite to the solar potential. Grid transmission studies also indicated the site had potential to feed approximately 50 MW of power into the existing distribution network.

'The project design and size of the wind and solar components was optimised by Windlab to generate as much power as possible subject to the 50 MW grid limit at the most economic cost. The final piece of the puzzle was a battery, which is used to save some of the power that would otherwise be curtailed due to the 50 MW grid limit, in addition to providing ancillary services and arbitrage revenue,' said Price.

Congestion on power lines and related transmission infrastructure is emerging as an increasingly big issue for renewable energy generating facilities. Although wind and solar are rapidly becoming the cheapest form of generation, the variable nature of such generation technologies means they do not always utilise the power network in the most efficient manner.

Price observed that Kennedy Energy Park perfectly demonstrates that at some sites with a complementary wind and solar resource, a hybrid project which combines wind, solar and a battery can greatly improve the utilisation of the transmission network. This, he said, allows for a much greater transfer of energy over the course of a year than would be possible from a project with just a single technology.

As storage costs continue to fall, he also believes that this sort of facility can utilise more storage, resulting in more reliable and consistent energy dispatch. 'A hybrid project can also bring benefits of

reduced capital and operation expenditure due to sharing of connection infrastructure and the on-site workforce,' Price added.

In Price's view, the key challenges facing hybrid projects such as Kennedy relate to what he describes as their innovative and pioneering nature. He highlighted the fact that many of the rules used to control the electricity market have not been designed to incorporate a mixture of technologies – meaning that the wind, solar and battery components must be registered and managed separately from a market perspective.

This prevents wind, solar and battery outputs operating in the most effective manner. To help in addressing these hurdles, Windlab is working with regulators to change some of these rules to allow the most efficient use of hybrid facilities.

Another challenge is related to the creation of bespoke financing, construction and operational contracts and performance guarantees for a hybrid facility. According to Price, learnings from Kennedy will enable all these contracts to be more quickly negotiated in future hybrid projects.

Construction on the energy park is now complete and final connection works are underway. The project is expected to be energised in the next two months.

Wheatridge Renewable Energy Facility

Another innovative project in the pipeline is the Wheatridge Renewable Energy Facility in Oregon – a joint initiative between Portland General Electric (PGE) and NextEra Energy Resources. Wheatridge is the first announced facility of its scale anywhere in North America to combine wind, solar, and storage in a single site.

When complete, PGE will own 100 MW of the wind resource, while NextEra will own 200 MW of wind, 50 MW of solar and 30 MW of storage – leaving PGE to buy the project's entire output via a PPA with NextEra.

According to Steve Corson, Head of Corporate Communications at PGE Renewables, the fact that the facility has not been constructed means that many technical decisions have not yet been made, including those relating to the technology and equipment to be used in the solar and storage components. Even so, he confirmed that the wind resource will be generated with 120 turbines manufactured by GE Renewable Energy. The majority of these turbines will be GE 2.5 127 models, with the remainder made up of GE 2.3 116 turbines.

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'The battery facility will be charged from the solar array and will be capable of delivering at full power for up to four hours,' Corson said. 'Naturally, that means it will be charged during daylight hours, and the output used to meet customer needs, as required. We anticipate it will be especially useful to smooth the transition to other resources when the solar or wind resources fall off.'

Integration challenge

The process of establishing the facility began when PGE issued a request for proposals for new renewable energy resources in 2018 and evaluated bids, submitting a short list of proposals to the Oregon Public Utility Commission for acknowledgement late in the year. After final negotiations with a subsidiary of NextEra Energy Resources, the Wheatridge facility was chosen as the winning bid.

Corson also stressed that the integration of the variable output of wind and solar facilities while maintaining system reliability poses a major challenge – particularly as renewable resources become an increasingly dominant factor in the company's energy mix.

'Storage offers important benefits in helping to address this challenge, and we expect it – using various forms of storage technology in various configurations within our system – to become more important as the technological options improve and costs decline,' he said. 'This storage facility will be the biggest battery system in Oregon, yet relative to the need it's still a small resource, so we are looking at other ways storage can be used to augment our system as well.'

Grand Ridge Energy Storage

Elsewhere in the US, energy storage company Invenergy has been operating the 3 MW Grand Ridge Energy Storage Expansion project in La Salle County, Illinois since 2016.

The Grand Ridge Energy Storage project is made up of a 210 MW wind farm, a 20 MW solar project and two energy storage units

Photo: Invenergy

The project, located some 80 miles southwest of Chicago, is made up of a 210 MW wind farm, a 20 MW solar project and two energy storage units – rated at 31.5 MW and 1.5 MW.

As Kaitlyn Howling, Storage Engineer at Invenergy, explains, the company added 3 MW of batteries to its existing energy storage system to participate in the PJM fast frequency response market. This addition entailed the installation of two 40-foot containers of batteries that feed into an existing transformer and connect to a wind farm.

The Grand Ridge Expansion operates in the PJM Reg D market, meaning that the system feeds directly into the grid to remedy small fluctuations in frequency. Invenergy played an integration role at this facility, working in coordination with the equipment suppliers to ensure all operating measures are enforced.

Howling reported that the Grand Ridge Expansion, along with all the other wind, solar and storage assets co-located at Grand Ridge, is controlled by Invenergy's Generation Management System, which is centrally located at the company's headquarters in Chicago. She also pointed out that the control system allows engineers to adjust control schemes to fine tune the operation of the battery system.

'Co-locating renewable assets has the advantage of cost reductions for shared facilities such as the substation and control infrastructure,' she said. 'On-site technicians can also be utilised as shared resources to reduce operating costs for all technologies.'

'The challenge is always controls,' Howling added. 'How can the power fed to the grid be controlled and enforced to interconnection standards while maximising value? Typically, there are multiple suppliers for the different renewable technology equipment and applications, which adds a layer of complexity. Having a centralised management system eases this challenge by allowing one single point of control for operators.'

According to Wood Mackenzie Power & Renewables, the global energy storage market is poised to expand 13-fold by 2024. Interest in dispatchable clean power has never been greater – and projects combining multiple renewables with batteries are an inevitable part of the global future of energy. ●

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