

Joined at the hip: A hybrid future for onshore renewables

Hybrids | With industry heavyweights eyeing up developments of solar-wind-storage projects, Liam Stoker uncovers what's really driving hybrid power plants, and the regulatory and financing hurdles that must be surmounted to deliver them



Credit: Getty

Such is the maturation of the renewables sector as we enter the 2020s that simply co-locating generation with storage is almost old hat.

Now renewables developers the world over are pushing the envelope even further, adopting their onshore wind cousins to bring forward hybrid projects that profess to unlock the full value of a grid connection and unleash the potential of onshore renewables as a whole.

As almost every nation eyes progress on climate targets, renewables proliferation looks set to soar in the coming decades. There will be no single technological solution either, with most countries calling upon a broad range of generation asset classes to play their role as renewables generation escalates. Indeed, the International Energy Agency – which itself has a track record of underselling renewables somewhat – forecasts there to be anywhere from 309 to 377GW of additional onshore wind generation across the world by 2024, second only to solar PV. The potential for the two most prolific onshore renewables to co-locate and share certain grid infrastructure is, therefore, perhaps obvious. Adding storage to the

mix to play a crucial flexibility-driven role is all the more sensible.

It's enough for some of the industry's largest players to sit up and take notice. In recent months, renewables developers the world over have announced major plays for the co-located or hybrid power market, proving that this trend is not limited by regionality.

A new normal

Iberdrola's UK-based utility ScottishPower unveiled in December 2019 a new strategy to retrofit solar *en masse* beneath its operating onshore wind assets in the country. French renewables developer Neoen, meanwhile, is to bring forward solar-wind-storage plants in Australia. NextEra Energy broke cover last summer to announce a 700MW hybrid plant in Oklahoma. Swedish state-backed energy giant Vattenfall has explored numerous such co-located generation assets, ranging from a pilot in Wales connected in 2017 to an upscaled project in the Netherlands set to come onstream this autumn.

Speaking at the time of ScottishPower's hybrid strategy unveiling, the firm's CEO Keith Anderson said the move was being

driven by a need for innovation to squeeze “the absolute maximum potential out of every clean energy project” if climate targets are to be reached. He said that in the UK and Ireland in particular, the “perfect blend” of clean power “should include a mixture of clean energy technologies”, invoking images of a future clean energy economy where technologies can dovetail in harmony.

ScottishPower evidently sees so much potential in this strategy that not only will it be retrofitting additional technologies to existing sites – ScottishPower owns and operates significant quantities of onshore wind in the UK – but also new projects will be delivered in a hybrid fashion as standard. “In the next 18 months I believe that hybrids will be the new normal for all renewable energy developers,” he said.

Nick Boyle, chief executive at prolific solar developer Lightsource BP, says co-locating resources stands to bolster the value of a generator's most valuable item: its grid connection. “Grid is your limiting factor, [and] you have a 30% utilisation on that. It's sitting there doing nothing for 70% of your time and, even though it's not as simple as that, why wouldn't you co-locate?” he says.

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Romain Desrousseaux, deputy general manager at international developer Neoen, says that his firm sees two kinds of hybrid power plants: those combining renewables with storage in an off-grid environment, something Neoen has been actively involved in since 2015, and newer forms of hybrid plants that co-locate multiple forms

of generation in pursuit of a smoother or flatter generation curve. Alongside a storage component, these plants could deliver something more akin to baseload power and more 'useful' energy to customers.

In September 2019 Neoen unveiled plans for a major hybrid power plant in South Australia, combining 1.2GW of wind, 600MW of solar PV and a 900MW battery storage facility. To be developed in three phases, the project hinges on the construction of a 330kV high-voltage interconnector between South Australia and New South Wales, which transmission system operators ElectraNet and Transgrid aim to have completed by 2023 at the latest.

The prospect of sharing a grid connection between three generation technologies of such size could trim costs, but Desrousseaux says that while it is indeed a bonus – especially in an energy economy driven predominantly by economics – the bigger advantage of hybrid sites lies in the actual output. "The biggest benefit to us, we believe, is in offering several types of energy which complement each other and allow you to offer either baseload, or the type of energy that would be required by the customers," he says, indicating the firm's preference for power purchase agreements to underpin hybrid developments.

But often, as developers have encountered, the financing of hybrid sites – especially those retrofitting additional technologies or capacities – is far from straightforward.

Hybrid hurdles

"What we've seen is retrospectively putting solar on a wind farm is difficult – but not impossible – if the assets have all been financed," Kareen Boutonnat, chief operating officer at Lightsource BP, says, throwing a potential hurdle to any developer's dreams of approaching already-built assets with a retrofitting option.

That sentiment is echoed by a number of developers and financiers spoken to for this feature. Mark Henderson, chief investment officer at UK renewables developer Gridserve, says retrofitting new technologies or capacities onto already-financed and operational projects threw up "all sorts of problems" and one that was "a great idea, but practically quite difficult", perhaps offering an explanation as to why comparatively few battery storage retrofits have been conducted to date. Aldo

Prototype power: A maiden co-location demonstrator for Vattenfall

In 2017 Swedish wind giant Vattenfall announced that it would be retrofitting its Parc Cynog wind farm in Carmarthenshire, Wales, adding a 4.99MW solar farm beneath the project's wind turbines, giving the project a 13.9MW generation capacity.

Both the wind and solar element were accredited under the country's Renewables Obligation scheme, propping up the project from a financial perspective. But far be it for financial reasons, the utility stressed at the time of energization that the prototype's development was so that it could learn from the experience and to "get some time generating under our belt" before the utility looked at exploring future developments.

The development itself was not exactly straightforward. Vattenfall had to switch sites, having previously identified an alternative wind farm in Leicestershire, owing to grid constraints, and committed to installing a power plant controller alongside network operator Western Power Distribution – and an element of curtailment from the solar element of the park – to gain approval.

This meant that as soon as combined output from the two technologies reached 4.1MW, the controller would kick in and curtail the solar array's output, with the wind generation deemed more valuable to the parties involved.

18 months later, Vattenfall provided an update to the UK market stating that the project's performance had been "very good", noting the complementary generation profiles of the two technologies.

Any fears over excessive curtailment were not borne out with the grid connection not maxed out "for the vast majority of the time", a company representative told sister publication Solar Power Portal at the time, while performance was suitable enough for Vattenfall to explore "all aspects" of maximising its asset base through co-location, both with additional solar and battery storage.

Beolchini, managing partner and chief investment officer at European investor NextEnergy Capital, echoed Henderson's comments, stating that while his fund was always actively looking at retrofitting opportunities and remained open to alternatives, adding new capacity was "not an easy one to deploy" and an opportunity that is still somewhat constrained by grid.

Such issues may go some way to explain why retrofitting existing assets may be restricted to multi-national utilities akin to ScottishPower/Iberdrola with the balance sheet and financial clout to do so, and why hybridisation has largely been constrained to new-build, freshly financed assets so far.

There are, too, obstacles holding back hybrid projects away from the finance community, not least of all within the regulatory landscape. As Alex Eller, senior research analyst at Navigant says, a lack of classification for hybrid projects that comprise multiple technologies from grid operators means they face more rigorous and time-consuming approval processes.

"In a lot of markets now there's not even a classification for energy storage, there's definitely not a classification for a solar-wind-storage plant. So because of that when developers go to their interconnection request [to] the utility, the grid operator has to study how the output of this project is going to impact the grid and because they don't have a lot of data on how they operate or the output profiles... they're either not allowed to build those projects or it's a very long and expensive process to do those studies versus just solar or just wind where it's more well-known and better understood what impact it might have," he says. Renewables technology would again appear to be outpacing regulation at a critical time for renewables policy.

Neoen's Desrousseaux concurs, saying that while he doesn't think grid operators are necessarily hesitant to approve hybrid projects, the problem is caused by a lack of operational data and the comprehensive modelling that's required for grid operators to hand over the keys to nationally



Credit: Vattenfall



Credit: Tesla

The now famous Hornsdale Power Reserve battery, owned and operated by Neoen alongside its Hornsdale wind farm

significant infrastructure. "When you start to put more equipment and more complex [projects] than one pure, simple technology, it's getting a bit more difficult. I don't think there's any issue from the grid, but there's usually a challenge to be able to provide all the analyses with several technologies rather than a single one," he says.

Another such issue to overcome, right at the design phase, is in site identification. As Desrousseaux says, wind and solar plants are usually sited as such because of either their strong solar irradiation or wind speed portfolios. But it's a rare occurrence for these two to overlap, requiring more careful consideration than the standard renewables site.

And then there's the issue of the site's construction and how that is managed. Solar PV, famed for its speed of build, is likely to outpace even the most hastily assembled onshore wind farm, causing the construction of hybrid sites to require careful consideration. Desrousseaux says that while Neoen's maiden hybrid site still awaits construction, the developer has planned in advance to coordinate the issue of the three technologies moving forward. Lightsource BP's Boutonnat is of a similar opinion, commenting: "There's been very little [hybrid development] done so far. It's not as easy as that because effectively the timing of wind and solar are different. You're not developing a wind and solar plant at the same time, it takes a lot longer [for wind]."

Given the numerous hurdles that need to be surmounted, and that there is not exactly a dearth of standalone solar, storage or wind developments globally,

what is it that is driving such interest in hybridisation, and what skillsets are necessary to be an early mover in this market?

Customer first

"I remember years ago making a statement that there would be more solar deployed in applications that we haven't even come up with yet in the next 20 or 30 years, than applications that we have now. And I absolutely still stand by that," Lightsource BP's Boyle says, commenting on the number of new applications solar finds itself in.

"We're seeing gas and solar, diesel and solar, wind and solar co-location, hydrogen, you name it. It depends on the need of a specific customer and what they want," Boutonnat adds. And it's this focus on the customer and their needs which can be a driving force behind hybrid sites. After all, a generator that produces power whether the sun shines or the wind blows stands to be a considerably powerful proposition for an off-taker.

Desrousseaux says that it is Neoen's belief that in bringing forward several sources of renewable power under one roof, or indeed under one grid connection point, there's a stronger opportunity to supply a wider array of end customers. This means identifying and selecting sites becomes paramount, however, placing importance on those teams within any would-be hybrid developer.

In turn, the financing and power purchase agreement (PPA) structures in place become more complex. Untangling PPA structures for a broader audience has been a particular bugbear for much of the

utility-scale solar industry in recent years, so some reluctance to muddy the waters with new structures taking into account hybrid plants of multiple technologies is perhaps understandable. As Desrousseaux explains, if a PPA is based on a project's modelled output, adding more generation technologies than usual – coupled with the presence of energy storage – only increases the risk of a modelling error or energy shortfall, therefore increasing the risk associated with it. "It requires some expertise and knowhow in terms of energy management and some solar developers haven't thought in that direction yet," he says.

For that reason, it is to be expected that developers have not adopted hybridisation if their end goal is to sell the project on to an investment fund or other asset holder, rather than own and operate those assets in the long term. And if the opportunities in standalone renewables are bountiful, hybrid developments may take longer to emerge from the drawing board and onto the land. "If solar requires to be, because of the economics, co-located with wind then that's when we would look at wind... but we have enough to do without taking on the wind boys as well," Boyle says.

For that reason, the prediction from ScottishPower's Anderson that hybrid developments could become "the new normal" within 18 months may seem far-fetched. But if renewables have become known for anything in recent years it's their unrelenting pace of change. If the industry can approach hybridisation with a similar mix of innovation and know-how, Anderson's assumption could yet ring true.

As Navigant's Eller says, even the simple co-location of utility-scale solar with storage five years ago was more complicated and a marginal market, but that has changed quickly: "Everyone knew it made sense but it took a while to really happen and get sorted out, then all of a sudden in the last year or two it's like everywhere, half the big solar projects that are built now have storage with them. It's become much more standardised; once it got figured out, everybody was comfortable with it, it just became the new thing. And I would imagine that's what we'll see here [with hybrids] too." ■

Turn to p.20 for insights into some of the technical challenges of hybridisation