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FEATURE: How Batteries and AI Help Increase the Resilience of Increasingly Dispersed Electricity Grids

by Bryony Collins

Battery energy storage and AI will be critical to strengthening the resilience of electricity grids as they become more dispersed and dominated by renewables, say energy experts.

As renewables roll out further and energy networks become increasingly dispersed, grids risk becoming fragile, leading to a need for flexible assets like batteries and AI to provide resilience and energy security.

Investment in electricity grids across Europe needs to almost double to provide the backbone behind an ever-growing amount of renewable energy, said European Commission Executive Vice-President for a Clean, Just, and Competitive Transition, Teresa Ribera.

Recent physical and cyber attacks on grids, coupled with blackouts in Spain and the UK, shows how vulnerable they can be, especially without reinforcement provided by flexible assets like batteries.

Yet "when managed correctly, distributed energy resources can make the grid more resilient than the traditional way with centralised facilities, where if there's a problem the whole system is affected", said Andressa Ferraz, global product manager of battery energy storage-as-a-service (BESS) at ABB.

Companies can earn revenue by using batteries to provide grid services like frequency regulation, while AI can cut cost for grid operators by detecting faults before they occur, enabling a shift from reactive to predictive maintenance.

"AI has moved beyond the hype, and is now proving its value across grid operations," Ferraz said. But there are also challenges with it, linked to cost, aging infrastructure, and the digital skills gap.

"We need to make sure we have resilient grids, resilient generation capacity, and resilient backup capacity .... this is going to get even more critical if we're going to electrify 80-90% of the economy," said Michael Lewis, CEO of German utility Uniper, at a recent event.

The share of renewable in the European electricity mix has increased to 47% from 34% since 2019, while the share of fossil fuels has dropped to around 30%, according to research by Ember.
Yet, as energy systems become increasingly electrified, the focus is turning to energy security and the need for a stable power supply, which batteries, AI, and behind-the-grid renewables can help provide.

OPPORTUNITIES

Battery energy storage systems (BESS) are a “main player to support grid resiliency” – providing backup to big power consumers like data centres at times of high energy prices or blackouts, said Ferraz.

ABB recently launched BESS as a service model, where it operates and optimises these assets on behalf of commercial and industrial customers, to reduce their carbon footprint, and earn revenue by providing ancillary services like frequency regulation to the grid.

Certain markets have the regulation in place to enable this, such as the UK, Ireland, Australia, Japan, and US markets like PJM, ERCOT (Texas), and CAISO (California), Ferraz told Carbon Pulse.

The behind-the-metre batteries ABB deals with are on average 500 kW to 20 MW in size, which have one to four hours of duration.

She acknowledged concerns that recent grid outages, such as in Spain and London, could be linked to the rise of renewables and a more dispersed grid, but said that “renewables themselves aren’t making the system more fragile”.

“It’s a transformation and we also need to strengthen the grid alongside to avoid certain risks from occurring,” she added.

“As more electrification of heat and transport occurs, there will be more problems locally, which will require more batteries to be spread out or distributed around the grid,” said Richard O’Loughlin, deputy CEO at GridBeyond, a provider of AI technology to manage distributed energy resources.

Local-level flexibility schemes will crop up, particularly where there’s a big growth in renewables but not much demand, or there’s lots of demand but not the wires to connect that to generation at peak times, and batteries can help to tackle this, he said.

Distribution network operators (DNOs) are creating flexibility programmes for organisations with onsite batteries or flexible processes to feed into – curbing their energy demand during peak hours and supporting the grid in the process, avoiding the need for large-scale infrastructure change. DNOs in the UK include Northern Powergrid and UK Power Networks.

The UK will likely be one of the more advanced grids in this respect, as well as the US, Australia, and Japan, he told Carbon Pulse.

Installing batteries behind the metre at data centres allows corporates to play a role in bringing flexibility to the grid, and also to hedge their exposure to volatile energy prices and to reach their net zero goals. It helps them to access new grid connections more easily, he added.

The growing use of AI is driving ever-increasing power demand, with the AI and cloud boom increasing Microsoft's emissions almost a quarter since 2020 despite decarbonisation efforts, and the surge in data centres across Southeast Asia threatening to derail energy transition goals.

Research from the VU Amsterdam Institute for Environmental Studies has found AI's power demand to be approaching that of the Netherlands, while the IEA estimated that all data centres (excluding crypto mining) consumed as much as 415 TWh of electricity in 2024.

AI TO CATCH PROBLEMS EARLY

Using artificial intelligence (AI) to manage grids and detect issues early can reduce the cost of maintenance by around 30% and curb operational expenditure by up to 40%, according to ABB.
Buzz Solutions in the US uses AI to quickly detect problems, or potential problems, on electricity grids before they get worse.

Its software analyses in-house utility data collected by helicopters, drones, and cameras, and quickly detects problem areas in the images, such as damaged cross arms, cracked insulators, vegetation encroachment, or rusted structures.

“We save utilities upwards of 70-80% in time just from the analysis of these issues and also save massive operational costs, which is a growing concern for them,” said Kaitlyn Albertoli, co-founder and CEO at Buzz Solutions.

In doing so, the company is helping utilities to inventory all of the assets they have deployed, and move towards a condition-based maintenance plan instead of being so reactive, she told Carbon Pulse.

This strategy helps with wildfire prevention, with increased renewables and electric vehicles straining the grid, and with ultimately preventing grid failure, she said.

Utilities need to very quickly build new transmission infrastructure at the same time as upgrading old infrastructure to cope with the big influx of new EVs, electric appliances, and data centres, and AI can help them identify where best to focus their efforts.

CHALLENGES

Utilities are increasing AI integration across core infrastructure to catch faults ahead of time, but there’s “still a tension between what is technically possible and what’s actually happening on the ground”, said ABB’s Ferraz.

AI deployment isn’t happening as fast as it could, largely due to companies perceiving it as a cost rather than a strategic investment, which can save them money in the long run, she said.
“Letting equipment run to failure, can cost 10 times more than maintaining it proactively, and that excludes the benefits of safety and regulation too.”

Another challenge is the digital skills required to manage this kind of infrastructure, with utilities struggling to attract and retain talent on cybersecurity and data analytics.

Legacy infrastructure is a further obstacle as many older systems weren’t designed for digital connectivity, which makes AI integration complex and expensive.

“If a system doesn’t have any sensors to provide visualisation then AI can’t work,” said Ferraz.