Energy storage for grid stability united kingdom

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Without additional investments to support the grid, scaling renewables to the levels required to meet the UK"s climate targets could result in substantial amounts of congestion. Indeed, bottlenecks in just one region of the UK grid could lead to up to 14.8 terawatt-hours (TWh) per year of curtailed renewable energy — wasting roughly 20% of the energy at that one bottleneck.

When energy is curtailed, more expensive generators are dispatched to take the place of cheaper generators, often renewables. The costs of constraint management in the UK today exceed ?1.1 billion per year and are expected to rise without intervention. When low carbon generation is curtailed, polluting generators such as natural gas are often required to ramp up to meet demand. This dynamic could lead to more than 5.5 million metric tonnes of additional greenhouse gas emissions per year by 2025. Congestion is a climate problem, not just an economic one.

Form modeled lithium ion, hydrogen stored in tanks and geologic formations, zinc-air, and aqueous metal-air technologies. Form optimized the various technologies" provision of ancillary services, capacity, and transmission support services at four key transmission boundaries on the UK grid in four different Future Energy Scenarios. Formware"s optimization relied on 10 years of hourly forecasts of electricity flows across the boundaries and hourly boundary capabilities (the maximum amount of electricity that could be transmitted across the boundary).

The results showed promise for energy storage: all technologies showed the potential to reduce curtailment and increase renewables utilization. At the "B7a boundary" in the UK system, a primary north-south transmission boundary and one of the most congested boundaries in

The technologies that delivered the most significant curtailment reduction had durations of greater than 40 hours, demonstrating the value of multi-day energy storage. These results underscore the need for innovation and demonstration – all of the technologies that delivered more than 50% reduction in curtailment are pre-commercial.

The outsized value of long duration storage was driven by the significant durations of potential congestion events. The durations of congestion events on the UK grid are expected to increase. By 2025, more than 12% of curtailment events will last for more than 48 hours, accounting for more than 60% of total curtailed energy. By 2025, nearly 20% of total curtailed energy will occur during curtailment events lasting more than 100 hours.

The potential for storage to support grid operations and renewable integration will vary from region to region and will depend on the regulatory and market context. Policy makers, grid operators, and their regulators can

examine the potential for storage on their grids, and, where results show promise – as these results do for National Grid ESO"s system – examine the Incentives and market structures needed to capture storage"s value.

Traditionally grid operators have relied on new grid infrastructure like power lines and transformers to meet new demand and move clean energy to where it"s needed. However, grid infrastructure can be costly and require long lead times to build, so grid operators like National Grid ESO are exploring new tools to support the existing transmission grid and maximize the benefits of future transmission expansion. National Grid ESO engaged Form to assess whether energy storage technologies could support the UK transmission system under future scenarios of renewable energy buildout.

Grid congestion occurs when the grid cannot supply demand in one region with the cheapest source of generation from another region, and is the result of the laws of physics that govern how power flows over electrical networks connecting the two. Attempting to move more power over a line than the line is designed to handle can cause the line to overheat or the grid to become unstable, risking fires or other failures.

When congestion occurs frequently and in large enough volumes, its costs add up. When the current or expected costs of congestion exceed the costs of solving the congestion, grid operators like National Grid ESO can take action. Historically, taking action meant building more or larger power lines or other types of transmission infrastructure. However, with the proliferation of new options like energy storage to support efficient grid operations, companies like National Grid ESO are increasingly evaluating alternatives to traditional network infrastructure.

Energy storage located "upstream" of a constraint can charge with the available low cost energy in excess of the transmission capacity, avoiding bidding off generators. This same asset can discharge when the line is no longer congested, displacing more expensive generation. Energy storage located "downstream" of a constraint can charge during normal operations and discharge when the grid is congested, avoiding offering on more expensive generation.

Form Energy used FormwareTM to identify the optimal quantity of storage, balancing the costs of building and operating storage against the value of the services that the storage systems could provide, such as congestion management, capacity, and reserves. Formware"s optimization relied on 10 years of hourly forecasts of electricity flows across the boundaries and hourly boundary capabilities (the maximum amount of electricity that could be transmitted across the boundary).

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