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Battery electricity storage is a key technology in the world’s transition to a sustainable energy system. Battery systems can support a wide range of services needed for the transition, from providing frequency response, reserve capacity, black-start capability and other grid services, to storing power in electric vehicles, upgrading mini-grids and supporting “self-consumption” of rooftop solar power.

In the longer-term, batteries could support very high levels of variable renewable electricity, specifically by storing surplus energy and releasing it later, when the sun is not shining or the wind not blowing strongly enough.

While pumped-hydro systems still dominate electricity storage (with 96% of installed storage capacity in mid-2017), battery systems for stationary applications have started growing rapidly. Wider deployment and the commercialisation of new battery storage technologies has led to rapid cost reductions, notably for lithium-ion batteries, but also for high-temperature sodium-sulphur (“NAS”) and so-called “flow” batteries.

In Germany, for example, small-scale household Li-ion battery costs have fallen by over 60% since late 2014. Steadily improving economic viability has, in turn, opened up new applications for battery storage.

Battery storage in stationary applications looks set to grow from only 2 gigawatts (GW) worldwide in 2017 to around 175GW, rivalling pumped-hydro storage, projected to reach 235 GW in 2030. In the meantime, lower installed costs, longer lifetimes, increased numbers of cycles and improved performance will further drive down the cost of stored electricity services.

Battery storage systems are emerging as one of the key solutions to effectively integrate high shares of solar and wind renewables in power systems worldwide. A recent analysis from the International Renewable Energy Agency (IRENA) illustrates how electricity storage technologies can be used for a variety of applications in the power sector, from e-mobility and behind-the-meter applications to utility-scale use cases.

Utility-scale batteries, for example, can enable a greater feed-in of renewables into the grid by storing excess generation and by firming renewable energy output. Furthermore, particularly when paired with renewable generators, batteries help provide reliable and cheaper electricity in isolated grids and to off-grid communities, which otherwise rely on expensive imported diesel fuel for electricity generation.

At present, utility-scale battery storage systems are mostly being deployed in Australia, Germany, Japan, United Kingdom, the United States and other European countries. One of the larger systems in terms of capacity is the Tesla 100 MW / 129 MWh Li-ion battery storage project at Hornsdale Wind Farm in Australia. In the US-State of New York, a high-level demonstration project using a 4 MW / 40 MWh battery storage system showed that the operator could reduce almost 400 hours of congestion in the power grid and save up to USD 2.03 million in fuel costs.

In addition, several island and off-grid communities have invested in large-scale battery storage to balance the grid and store excess renewable energy. In a mini-grid battery project in Martinique, the output of a solar PV farm is supported by a 2 MWh energy storage unit, ensuring that electricity is injected into the grid at a constant rate, avoiding the need for back-up generation. In Hawaii, almost 130 MWh of battery storage systems have been implemented to provide smoothening services for solar PV and wind energy.

Currently, utility-scale stationary batteries dominate global energy storage. But by 2030, small-scale battery storage is expected to significantly increase, complementing utility-scale applications.

Overall, total battery capacity in stationary applications could increase from a current estimate of 11 GWh to between 180 to 420 GWh, an increase of 17- to 38-fold.