Large-scale battery storage: Challenges and opportunities for technology and policy

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In September of 2016, a violent storm left South Australia without power. At the time, 57% of the region's power came from wind and solar—a stark contrast to the coal-dominated energy mix of its neighbors to the east. To some politicians and backers of coal, it was proof that renewable energy couldn't be trusted. To renewable energy pioneers, it was a technical challenge: could a large-enough battery cushion the swings in wind and solar power?

In a recent review article published in MRS Energy & Sustainability, energy experts weigh in, considering—among other factors—the political and legal ramifications of going big with batteries.

The summer after South Australia's big blackout, the state government doubled down and announced the construction of the world's biggest battery. Within 100 days, the clean-energy company Tesla delivered a 129-MWh lithium-ion battery, all for $91 million without government subsidies.

A clear win for renewable energy, the South Australian example is also being emulated elsewhere in Australia, although this path has inherent challenges.

On the technical side, there are issues such as power density, lifetime, and materials sourcing.

Solid-state batteries offer high energy density but low power density because of their relatively slow charge delivery. So despite protecting against blackouts, the batteries could still be vulnerable when fast responses to peak energy demands are required.

Another limitation of lithium-ion tech is a relatively short lifetime. With each charge-and-discharge cycle, batteries come one step closer to their end-of-life-a
problem exacerbated by the harsh conditions that make wind and solar havens attractive in the first place.

Finally, with increasing scale, sourcing raw materials for lithium-ion batteries may become problematic. Particularly, the cobalt used in battery cathodes is a limited resource-with a large portion derived from conflict zones operating under practices that violate basic human rights. Basic research into emerging technologies is critical in this context. Metal-air, sodium-ion, or lithium-sulfur batteries might relieve some of the burden lithium-ion technology currently faces.

Similarly, in the realm of policy, there is much to be done. The rise of solar and wind, buttressed by large-scale battery storage, represents a challenge to the fossil-fuel-dominated status quo. But measures for accommodating renewable energy exist.

One approach, as adopted in South Australia, is to offer government contracts to provide rapid-response grid support services. Tax incentives and feed-in tariffs can also incentivize producers big and small. Though both require certainty for investors and careful administration. Likewise, legislation, such as California's mandate requiring 1.9 GW of storage, can facilitate investment by creating certainty for project developers in the growing storage industry.

In these and many other ways, the large-scale battery facility installed in South Australia represents a fascinating case study. How the giant stack fares is and will continue to be instructive to researchers and policy makers alike around the globe. Their decisions going forward will undoubtedly hold significant implications for the environment amid a rapidly changing climate, as electricity grids transition to a situation where renewables dominate electricity supply rather than sit on the
On-grid batteries for large-scale energy storage: Challenges and opportunities for policy and technology

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