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BATTERIES FOR LARGE-SCALE ELECTRICITY STORAGE

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Increasing availability and declining cost of lithium-ion batteries has brought rapid gains in the capacities of battery electric storage (BES). In 2017 came Tesla's 129 MWh battery storage Hornsdale project in Australia, in 2019 Florida Power and Light (FPL) announced its 900 MWh Manatee storage to be completed in late 2021, but in early 2022 it got surpassed by California's Moss Landing (a large natural gas-fire plant) where Vistra Corporation installed the world's largest battery storage with 400 MW and four-hour capacity, hence able to deliver 1,600 MWh. National Renewable Energy Laboratory quotes $350/kWh as the cost of four-hour Li-ion battery storage in 2020, putting the project's total cost at $560 million. This represent a considerable capacity gain in just a few years, but it is still only a fraction of the world's largest electricity storages. All of them are pumped hydro storage (PHS) projects that have been around for more than a century: their operation uses two large reservoirs separated by a short horizontal but relatively large vertical distance: water is pumped (usually by reversible turbines) into the top reservoir when overnight electricity prices

are low and discharged (generating electricity) during the hours of peak demand.

Fengning, the world's largest PHS in China, has power of 3,600 MW and storage capacity of about 40,000 MWh, America's largest PHS, Bath County in Virginia has power of 3,003 MW and overall storage capacity of 24,000 MWh, Japan's Okutataragi is rated at 1,932 MW with storage capacity of 15,500 MWh. This means that these projects have, respectively, nine, 7.5 times and nearly five times higher installed power than Moss Landing BES and up to 25 times higher storage capacity. They will also last longer (many decades) than Li-ion batteries, and cost less, although future decline of battery cost should bring the two rates closer together. And as large as the recent BES projects are, they would have to become considerably larger to provide high peak demand or emergency reserves for large utilities.

For example, Japan's Tokyo Electric Power Company experiences common power peaks over 40 GW which means that a battery storage able to supply such need for just two hours would have to be 50 times larger than Moss Landing, the current record-holder, and that (even at $250/kWh) it would cost $20 billion. Moreover -- much like any large-scale hydroelectric project and unlike battery cells -- pumped hydro storages can operate reliably for decades, while in September 2021 the world's largest battery storage suffered an outage of its original 300 MW assembly due to overheating (scorched battery racks, melted wires) and then a similar incident to its 100 MW addition in February 2022.

(Disclaimer: The views and impressions in the columns are personal opinions of Prof. Smil and do not represent the opinions of ICEF.)