Energy Storage – first in a five-part series

This article is the first in a series of five articles on energy storage. As a whole, the series serves to provide context and expose the considerations to understand and evaluate tactical and strategic actions being taken by utilities, developers, and regulators to provide the storage solutions needed for the future. This series will provide the reader with a primer on stationary storage and its long-term importance to supply reliable, inexpensive, and environmentally attractive electricity for a viable society. Overview Electricity storage (storage) is a set of technologies that stores previously generated electric energy and releases that energy later. Without storage, electricity needs to be produced, delivered, and consumed nearly instantaneously for the grid to maintain balance. Until recently, storing electricity across the electric grid was limited, but recent advances in new energy storage technologies are making the wide-scale deployment of electricity storage viable. Big "WHYs" of Storage With many predictions, as their realization shifts from fantasy to reality, clarity emerges on why storage has taken so long. A confluence of factors was required to drive its current rapid evolution. The overarching factor is carbon-free energy, but storage has two major roles in achieving it. The first and arguably most important role is in transportation. Electrified transportation eliminates emissions while maintaining societal mobility.

Second, stationary storage provides operational flexibility for the energy sector by either producing or consuming energy upon command. A zero-carbon electricity supply's intermittency drives stationary storage's role. The most abundant renewable resources - wind and solar - are also the least flexible, predictable, and controllable. Stationary electricity storage represents a "spring" to be compressed when renewable electricity is abundant and released when not. Further, it brings flexibility. For transportation, energy density (range) and charge time (refueling) are critical. Stationary storage charge pace can be engineered to meet the required flexibility. Challenges Longevity and duration represent stationary storages' major challenges. The former, because stationary storage costs are recovered over its life, and the critical factor is the number of times it is charged and discharged.

Although other factors, such as speed and depth of charge, the number of charge/discharge cycles impact storage longevity the most. The storage duration is the second major challenge. Second and minute horizon stationary storage provides regulation and spinning reserves more flexibly than fossil alternatives. Two-, four-, eight-hour storage provides the flexibility to capture abundant solar during the day, serving daily peaks in the evenings. Weekly, monthly and seasonal storage preserves surplus solar, wind, and hydro-produced electricity for release during supply shortages and peaks, which for some in North America occur on cold, dark, and still winter mornings. What about cost? Cost is critical but, again, differs between the transportation and energy sectors. For the former, manufacturing cost is paramount because it significantly contributes to the overall vehicle cost. Manufacturing cost is also important for stationary storage, but other costs, such as land, deployment, and interconnection, weigh heavily on the final cost. Also, longevity, duration, and cost are coupled.

Return-on-equity favorability increases for assets with longer lives (cycles) and offering greater flexibility (duration). Further, stationary storage valuation complexity increases because longer duration storage implies fewer cycles during a given assets' life. Thus, the transition from a future solution's promise to its realization is not easy, pretty, or simple. Next in the series, This article is the first of a five-part series on storage. The second will address Li-NMC technology and why it will remain dominant soon. The third identifies emerging, possibly competitor technologies for stationary storage. The fourth article examines the necessary scale and practical applications of stationary storage in a transformed electrical landscape. The final will provide insight into the future, identifying possible opportunities.