Lifetime Cost of Ownership Comparison of Utility-scale Energy Storage Solutions

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Abstract

As fossil fuels have inherent energy storage, replacing them requires storage capacity to be low cost. Storage, like Work In Progress (WIP) adds no inherent value itself; however, comparison of storage technology economics is often based on short term horizons which can be misleading when used to compare technologies with very different useful lifespans.

Here we present an analysis method framed around the lifespan of the longest-lived solutions, using extrapolated cost curves, replacement, maintenance, end of life cost cycles, and capital costs to compare the relative total cost of ownership of infrastructure investments in contending storage solutions. We performed a meta-study of published data, extracted key parameters and projections, and performed regression analysis of actual data to date and consensus forward projections to extend the projections to 2100. From these data models we constructed a cost model of long term infrastructure investment in utility-scale energy storage we believe is helpful in guiding long-term infrastructure investments, particularly at a national scale, and catalyzing technology development.

Our analysis shows that many of the existing studies of storage technologies are based on idealized assumptions which ignore the costs of predictable long-term aging that result in an upward revision of projected costs for storage systems with consumable components or storage media. As an example, consider the comparison of pumped storage hydroelectric (PSH) and Lithium ion batteries where the former is often cited as costing 30% more to install, yet the latter must be replaced every 10 years. With a Weighted Average Cost of Capital of 6.5% and an 80 year time horizon, PSH is 30-50% lower total cost of ownership than Li ion batteries.

It is essential to evaluate the full-lifetime costs of storage options to ensure effective deployment of finite capital resources to handle the immediate growing need, as well as direct R&D.