# St george utility-scale energy storage

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With declining costs, improved technologies, and increasing deployment, energy storage is poised to become a growing part of the evolving U.S. power system. But measuring the value of energy storage is inherently complex--and future systems will likely include multiple storage technologies, adding new complexity.

To answer the big questions around the role of storage in our future grid, the National Renewable Energy Laboratory (NREL) has launched the multiyear Storage Futures Study (SFS). Supported by the U.S. Department of Energy"s (DOE"s) Energy Storage Grand Challenge, the study explores how energy storage technology advancement could impact the deployment of utility-scale storage and adoption of distributed storage, as well as future power system infrastructure investment and operations.

"To ensure cost-optimal deployment of storage technologies, we need careful analysis," said Nate Blair, SFS project lead and group manager of the Distributed Systems and Storage Group in NREL"s Strategic Energy Analysis Center. "The Storage Futures Study--specifically this vision for four phases of storage deployment--uses trends, projections, and analyses to develop a first-of-its-kind framework to help utilities, regulators, and developers prepare for the future."

Assuming the cost of most storage technologies increases with duration, the analysts make a case for deployments following a natural progression from shorter to longer duration over time, particularly aligned with current and anticipated growth in photovoltaics and wind power. Phase one builds on the long history of energy storage on the grid that has been primarily supplied by pumped storage hydro, and which is by far the dominant source of energy storage today with 22 gigawatts installed on the U.S. electric grid.

In phase one of the proposed framework, short-duration storage provides operating reserves to the grid--increasing or decreasing output for a short amount of time to help maintain the balance of supply and demand on the grid.

"Phase one of storage deployment has already been underway since the early 2000s, when wholesale markets allowed for storage to directly compete with traditional resources," said Paul Denholm, NREL analyst and developer of the framework. "This has resulted in significant deployments of energy storage in the United States of durations of 1 hour orless."

Monetization of existing frequency response requirements, additional market products, and growth in regulating reserves from variable generation could increase the deployment of storage in phase one.

Falling battery prices have introduced the opportunities for phase two--the deployment of batteries with 2-6 hours of duration to meet peak demand on hot summer days or in extreme cold.

Batteries" cost-competitiveness is based on their ability to provide the samelevel of peaking capacity compared to traditional resources such as gas turbines. NREL analysts found significant opportunities for batteries with 4-hour durations.

In this phase, the cost-competitiveness of battery storage increases with hybrid system configurations, where storage is co-located with renewable generation sources, particularly solar photovoltaics, to receive an investment tax credit. In addition, cost-competitiveness increases when demand for additional capacity increases or traditional sources retire.

Decreased value of shorter-duration capacity marks the transition to phase three--the advent of storage technologies that can provide additional or lower-cost services to meet longer peak periods.

"In this phase, shorter-duration storage plants can still provide capacity at a reduced capacity credit," Denholm said. "Various system configurations can offset the reduced capacity credit through opportunities like absorbing curtailed energy in a high-solar future."

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