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Role of long-duration energy storage in variable renewable electricity systems

Research brief for the academic publication in Joule:
"Role of long-duration energy storage in variable renewable electricity systems"
https://www.cell.com/joule/fulltext/S2542-4351(20)30325-1

Additional submitted attachment is included below.

NEW ENERGY OPTIONS

RESEARCH BRIEF

JULY 2020

KEY POINTS FOR DECISION-MAKING

- **To make 100% renewable reliable electricity more affordable, include currently available long-duration storage technology.** Long-duration storage would reduce costs of reliable solar and/or wind systems with or without battery storage.

- **Long-duration storage plays unique roles, such as seasonal and multi-year storage, that increase the affordability of electricity from variable renewable energy.** Long-duration storage meets demand during summertime lulls in wind power, and fills in for interannual variations in wind and solar power. Reliable systems that plan for more years increasingly depend on long-duration storage.

- **Variable renewable electricity costs are more sensitive to reductions in long-duration storage costs than they are to reductions in battery costs.** Technology innovations and future cost improvements in long-duration storage could further reduce the cost of renewable, reliable electricity.

Underground gas storage facility

Reduce the cost of reliable renewable electricity with long-duration energy storage

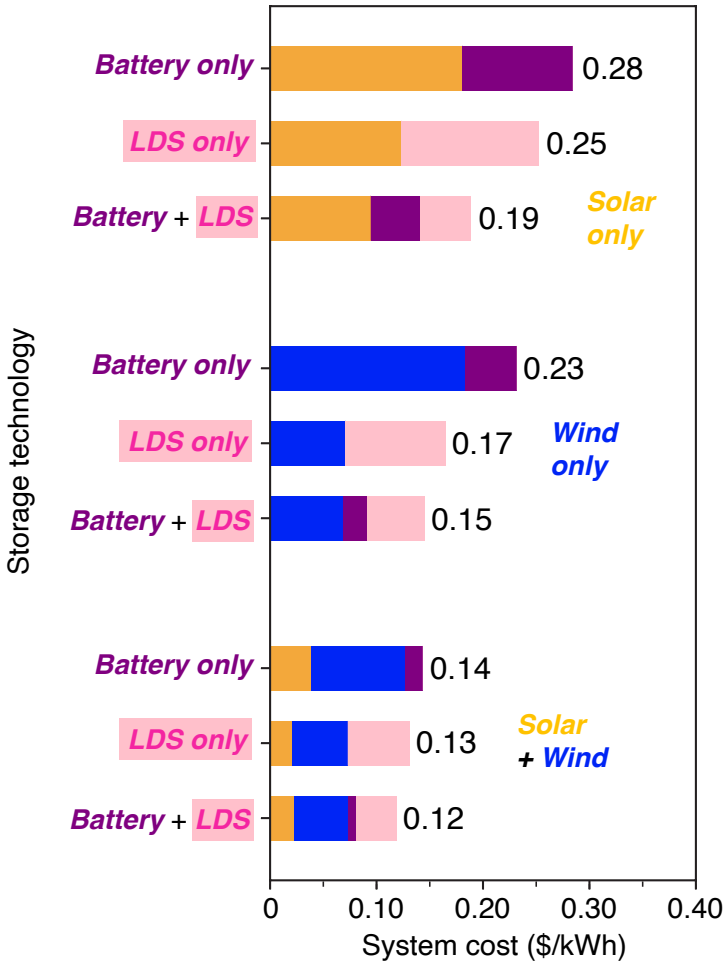
Several U.S. states mandate zero-carbon electricity systems based primarily on renewable technologies such as wind and solar power. Reliable and affordable electricity systems based on these variable resources may depend on the ability to store large quantities of low-cost energy over long timescales. Multi-decadal datasets reveal the role and value of long-duration (10 hours or greater) energy storage, and inform policy and technology investment decisions.

The inclusion of long-duration storage lowers costs of renewable electricity systems over a range of modeled technologies. These system benefits remain robust across multiple decades of historical wind and solar weather data, for different electricity systems (solar only, wind only, wind and solar), with and without battery storage, in the U.S. and three of its regional power grids.

A 10% reduction in long-duration storage costs would reduce electricity system costs twice as much as would a 10% reduction in battery costs. As a complement to long-duration storage, Li-ion battery storage may be used for less than 10 hours, such as overnight. Costs of charging and discharging, rather than costs of storage facilities, dominate long-duration storage costs. One long-duration energy storage example, power-to-gas-to-power technology with renewable hydrogen gas, would benefit greatly from continued innovations in fuel cells, electrolyzers, and other conversion devices.

Summary

Long-duration storage would offer multiple cost advantages for electricity systems that depend on wind and/or solar generation technologies. Long-duration storage avoids overbuilding generation, reduces reliance on short-term battery storage, and provides an expanded suite of low-cost options to deploy systems with a range of generation asset mixes. Indeed, long-duration storage would facilitate an affordable transition to meet wind and solar mandates beyond 80%, and open a path to 100% carbon-free electricity.



Renewable electricity system cost relative to storage and generation technology. Regardless of the wind/solar mix, introduction of long-duration storage, LDS, may reduce total system costs relative to a battery only system. Adding LDS to the solar/battery system through power-to-gas-to-power technology decreases the system cost by 32%.

NEW ENERGY OPTIONS

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Electrolysis frees hydrogen for long-duration energy storage

FOR MORE INFORMATION

Visit the New Energy Options website at new-energy-options.org.