Short term storage systems

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Integrating more renewable energy and balancing the grid requires utilities, businesses, and even homeowners to embrace energy storage systems. Excess energy can be captured and stored when the production of renewables is high or demand is low. When demand rises, the sun isn"t shining, or the wind isn"t blowing, that stored power can be deployed.

While the concept of banking excess electricity for use when needed sounds simple, energy storage can be complicated but it is critical to creating a more flexible and reliable grid system. This article explores the types of energy storage systems, their efficacy and utilization at different durations, and other practical considerations in relying on battery technology.

Renewable energy for residential homes, primarily wind and solar power, accounted for 81% of new capacity added globally in 2021. The worldwide push to replace power generated using fossil fuels is growing exponentially, with renewables projected to comprise 95% of power capacity growth through 2026. Some forecast that 80% of U.S. electricity will come from renewable sources by 2050. That transition escalates demand for energy storage technologies that will bank excess power from renewables and both short-discharge it when needed on a short-term and longer-term basis.

True resiliency will ultimately require long-term energy storage solutions. While short-duration energy storage (SDES) systems can discharge energy for up to 10 hours, long-duration energy storage (LDES) systems are capable of discharging energy for 10 hours or longer at their rated power output. Both are needed to balance renewable resources and usage requirements hourly, weekly, or during peak demand seasons and enable the phase-out of traditional sources of electricity.

SDES instruments are becoming more widely used on local levels as property owners add battery walls and other storage mechanisms to manage their energy use, integrate renewables, and use smart panels to schedule device usage. Battery arrays are the short-duration stabilization technology of choice for many because they can be installed quickly, respond when discharging is needed, and have high round-trip efficiency to ensure maximum output. Here are some options:

LDES systems are needed to help realize the potential of renewable power generation throughout the country. Some, including scalable SDES systems like flow batteries, are deployed in places, but more cost-effective viable options are needed. Here are some LDES options:

Other types of LDES systems expected to be adopted for use include compressed air energy storage and liquid air energy storage. The adoption of these technologies has the same constraints as hydropower, thermal storage, and hydrogen-based options in terms of location suitability challenges and cost constraints. Considerable effort and funding are being deployed to develop new or more cost-effective LDES technologies.

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By some estimates, the need for LDES in 2040 will be 400 times the present-day level.

Like a common household battery, an energy storage system battery has a "duration" of time that it can sustain its power output at maximum use. The capacity of the battery is the total amount of energy it holds and can discharge. An SDES with a duration of 4-6 hours in a home may be used to keep the lights on or the refrigerator cold during an outage. On a broader scale, utility-sized SDES systems may be used to replace wind power on a day with no wind.

Different battery chemicals affect the energy storage duration achieved. Lithium-ion storage systems currently dominate the space, reportedly comprising approximately 90% of storage capacity in use in the U.S. The use of other battery technologies is growing as the industry works to mitigate concerns about the limited lithium supply and meet growing demand.

The two other battery technologies being widely utilized are lead and VRFB, but there are factors to consider when selecting the most appropriate battery chemistry for the energy storage need. Both technologies are mature, with lead batteries originating in the 19th century and VRFB technology being developed by NASA over 50 years ago.

Lead batteries are the most sustainable, being composed primarily of recycled materials. They reportedly have a recycle rate of 99%. Lead works best for shorter durations and shallow depths of discharge. Additional battery cells can be linked to increased duration, but they are not designed to be LDES options. They can last decades, depending on usage and maintenance. A lithium battery is only useful for 10-15 years.

VRFBs are ideal for short- or long-duration energy output with very low degradation of components. The flow tanks can easily be expanded to increase duration and allow utility-scale deployments. They last far longer than the other options, with a 20- to 30-year lifecycle being common.