# 320 kWh battery solution

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As the demand for energy continues to rise, the demand for renewable energy capture is also increasing. Americans consumed about 4 trillion kWh in 2023, up almost 4 percent from 2020. Renewable energy sources contributed about 25 percent of electricity generation in the U.S. last year and is expected to double by 2050.

As more renewable energy sources come online, the power grid needs to become more flexible to develop the capacity to maintain the supply-and-demand capacity. This is where long-duration energy storage is key. However, defining long-duration energy storage (LDES) presents several challenges.

One definition of long-duration energy storage is qualitative, referring to energy storage installations that can store renewable energy until needed. The necessary duration varies significantly depending on the use case. It can range from a few hours to multiple days depending on many factors.

The second use of the term is the quantitative definition - the length of time that a system can sustain its maximum discharge rate. The system"s rating outlines kilowatts (kW) and megawatts (MW), along with kilowatt-hours (kWh) and megawatt-hours (MWh). The duration varies at the rate at which it is discharged, so duration is usually stated as a range.

A consistent definition for LDES would create a common language and a shared understanding among stakeholders about the role of long-duration energy storage. The terminology will continue to evolve as technology advances and the need for energy resiliency increases.

Short-duration energy storage systems can range from minutes up to two hours. These systems commonly act as a bridge providing maximum efficiency and reliable power for various applications, including uninterruptible power supply (UPS), data centers, telecom, utilities and emergency lighting.

Medium-duration applications require energy storage from two to four hours. As power demands on the aging grid increase, medium-duration BESS can help keep critical operations, such as military bases and hospitals, online in the event of a blackout. They can also power microgrids, both for isolated individuals disconnected from the wider grid who operate using renewable sources and for smaller buildings, neighborhoods or villages that still have access to the grid .

Long-duration can range from anywhere to six to 12 hours. Long-duration BESS is a crucial grid support tool, providing rapid response capabilities to mitigate fluctuations, stabilize voltage and enhance overall grid resilience. It also allows for renewable integration, storing excess energy during periods of high renewable generation and releasing it when demand peaks to ensure a balanced and sustainable energy supply.

The three battery chemistries most likely to be utilized are lead, lithium, vanadium or other flow battery technologies. Lead is the most commercially mature and has been the primary energy storage solution for over 100 years. Lead batteries can have a useful lifespan of up to 30 years, depending on the design and applications.

Lead batteries are the leader in sustainability, with a nearly 100 percent recycling rate. The lead battery industry has a well-developed circular economy that reuses and recycles the lead, electrolyte and plastic components of used batteries.

Currently, lithium is the least sustainable of the three chemistries. Due to the cost and complexity of the process, the recycling rate is less than five percent. While recycling processes are not yet widely available, this rapidly evolving area must improve the capture of critical materials from spent lithium batteries.

Vanadium is the least commercially mature but has the potential to become a leading solution for BESS. Vanadium battery technology has a near-infinite cycle life. This longevity complements the lifespan of wind and solar installations, which makes vanadium well-suited for long-duration energy storage.