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## Article

# Unlocking the Benefits of Battery Energy Storage Systems

Battery energy storage systems (BESS) have emerged as a powerful technology, transforming the energy landscape by enhancing grid reliability, supporting renewable energy integration and providing economic benefits to utilities and communities. As the demand for electricity continues to rise and as utilities continue to decarbonize, BESS's role in the energy infrastructure cannot be overstated.



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as opposed to the minutes or hours needed for other generation sources, playing a crucial role in mitigating market volatility and stabilizing the grid. Large and sudden changes in energy supply or demand cause strain on the grid as connected generation sources adjust to meet the appropriate demand. The ability of BESS to respond quickly to these large fluctuations is particularly valuable as they help maintain the frequency of the grid, also called frequency regulation, a key factor in a stable grid and reliable power delivery.

From an economic perspective, BESS help optimize energy costs and improve the overall efficiency of the energy market. By charging when energy prices are low and discharging when prices are high, BESS maximize cost savings and enhance grid stability. In the long run, this will help utilities achieve their sustainability and decarbonization goals.

## Factors Contributing to a Good Area for BESS Installation

Choosing the right location for BESS installation is crucial to maximizing its benefits. The following are a few questions to consider when determining the optimal area for these systems.

**How congested is the grid in the area?** Evaluating the levels of grid congestion in a potential installation area is essential as BESS can alleviate some of this congestion by providing additional energy capacity to balance supply and demand. This would enhance the overall grid stability and reliability.

**What are the plans for grid investments in the area?** Evaluating the extent of planned grid investments in an area helps understand future energy demands. Areas with planned investments are likely to see

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and support the efficient use of resources.

**How volatile is the market?** Evaluating the spread of energy price levels and energy volatility in an area can indicate whether BESS can be a long-term investment. The [EIA reports](#) that arbitrage is the primary use case for 10,487 MW of battery capacity, meaning that owners charge batteries by buying electricity during low-cost periods and then selling that electricity when prices increase. In regions with high energy costs, storing energy when it is cheap and selling it when prices are high can make these systems a financially beneficial option.

**Is renewable energy popular in the area?** Regions with solar or wind power are ideal for BESS installations. Renewable energy sources' variability can cause grid instability, which BESS can mitigate by storing excess energy and providing it when renewable generation is low. Some system operators have been exploring opportunities to update or replace existing [black start assets](#) with battery storage technology.

## Rapid Growth of BESS and Key Tools for Integration

In the United States, battery energy capacity is projected to triple by 2028, driven by renewable energy adoption, economic benefits such as arbitrage, technology advancements and more. The U.S. electricity demand is [projected to increase](#) by 500 TWh by 2030. This rise in power demand, particularly because of the rise of electric vehicles and data centers, shows the need for expanded energy storage solutions to continue delivering reliable and sustainable energy for communities and utilities.

Currently, lithium-ion battery energy storage systems are the undisputed market kings, capturing the majority of storage projects by

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... the immediate future.

However, an underrepresented and growing portion of the market to date are medium to large projects providing some other service, such as energy support for critical or uninterruptible services, cost reduction for load centers, localized black start for on-site power resources, and even combinations of these functions.

For all these applications and other specialized energy storage projects, a more fully integrated power plant controller (PPC) is required to manage the multiple load centers, complex switching, and different energy sources than what a typical off-the-shelf site BESS controller or EMS would provide. The PPC must successfully integrate controllers from different suppliers, data from meters and protective relays, as well as energy storage equipment. This requires the development of custom algorithms and control graphics, detailed testing in simulation, factory acceptance testing of controls and critical components, and on-site tuning for successful integration. A one-size-fits-all approach will not serve all customers in this critical market. Project success hinges on selecting the right team with the right credentials and experience in complex power plant control systems, including the integration of multiple equipment manufacturers under a unified site controller.

The future is here with battery energy storage systems, offering reliability, economic benefit, and overall technological and energy advancement. The demand for electricity will only continue to rise and BESS will play a critical role in delivering stable and reliable energy to meet power needs. By understanding the potential of these systems, factors that contribute to good BESS installations and crucial developments for successful integration, utilities and communities can reap the benefits of resiliency, reliability and sustainability.

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