Using Battery Storage for a Sustainable Electrical Grid

As we transition to decarbonized energy systems, energy storage technologies will be critical for supporting the widescale development of renewable energy sources. As the overall percentage of renewable energy sources increases, it brings with it new challenges. These challenges include the strain on existing power generation, transmission, and distribution infrastructure created by new flows of electricity and by the inherent variability of renewables, including potential imbalances in supply and demand, changes in transmission flow patterns, and the potential for greater grid instability.

Many industry experts argue that timely development of energy storage systems with government support would enable the energy systems to function smoothly with a large share of power coming from renewables, and thereby making a substantial contribution to decarbonizing the economy.

The electric power grid operates based on a delicate balance between supply (generation) and demand (consumer use). One way to help balance fluctuations in electricity supply and demand is to store electricity during periods of relatively high production and low demand, then release it back to the electric power grid during periods of lower production or higher demand. In some cases, storage may provide economic, reliability, and environmental benefits. Depending on the extent to which it is deployed, electricity storage could help the utility grid operate more efficiently, reduce the likelihood of brownouts during peak demand, and allow for more renewable resources to be built and used.

About Energy Storage

Energy can be stored in a variety of ways including Pumped Storage Hydroelectric, Compressed Air, Flywheels, Thermal Energy Storage, and Batteries. According to the U.S. Department of Energy, the United States had more than 29 gigawatts of electrical storage capacity as of 2021. Of that, 92 percent was in the form of pumped hydroelectric storage with most of that being installed on the 1970s.

Pumped Storage Hydropower Penstocks

Currently, pumped storage hydropower is the most widely used storage. However, batteries are the most scalable type of grid-scale storage, and the market has seen strong growth in recent years. Other storage technologies play a comparatively small role in current power systems. Additionally, hydrogen, an emerging technology has potential for the seasonal storage of renewable energy.

Batteries, or more accurately, battery energy storage systems (BESS) are projected to account for the majority of storage growth. According to the International Energy Agency (IEA), installed grid-scale battery storage in the United States was 0.3 GW in 2019, 1.1 GW in 2020 and 2.9 GW in 2021. The growth rate year-to-year of installed BESS is expected to increase significantly due to the lower cost of deploying BESS and regulatory incentives.

In the United States, several states have set dedicated targets for storage. In January 2022 the governor of New York committed to doubling the state's energy storage target, aiming for the deployment of at least 6 GW of storage by 2030. Furthermore, the Inflation Reduction Act passed in August 2022 includes an investment tax credit for stand-alone storage, which is expected to boost the competitiveness of new grid-scale storage projects.

Transmission and distribution investment deferral (using storage to improve the utilization of, and manage bottlenecks in, the power grid) is another potential high-value application for storage, since it can reduce the need for costly grid upgrades. To capture the greatest benefit, storage should be considered, along with other non-wire alternatives, in the transmission and distribution planning process. A key issue is ownership: in many markets, storage is considered a generation asset and system operators (transmission as well as distribution) are not allowed to own storage assets. One solution is to allow them to procure storage services from third parties. However, regulatory frameworks need to be updated carefully to minimize the risk of storage assets receiving regulated payments and undercutting the competitive power market.

Environmental Effects of Electrical Storage

Storing electricity can provide indirect environmental benefits. For example, electricity storage can be used to help integrate more renewable energy into the electricity grid. Electricity storage can also help generation facilities operate at optimal levels and reduce use of less efficient generating units that would otherwise run only at peak times. Further, the added capacity provided by electricity storage can delay or avoid the need to build additional power plants or transmission and distribution infrastructure.

Potential negative impacts of electricity storage will depend on the type and efficiency of storage technology. For example, batteries use raw materials such as lithium and lead, and they can present environmental hazards if they are not disposed of or recycled properly. In addition, some electricity is wasted during the storage process.

Battery recycling has the potential to be a significant source of secondary supply of the critical minerals needed for future battery demand. Targeted policies, including minimum recycled content requirements, tradeable recycling credits and virgin material taxes all have potential to incentivize recycling and drive growth of secondary supplies. International coordination will be crucial because of the global nature of the battery and critical minerals markets.

Batteries that no longer meet the standards for usage in an electric vehicle (EV) typically maintain up to 80% of their total usable capacity. With EV numbers increasing rapidly, this amounts to terawatt hours of unused energy storage capacity. Repurposing used EV batteries could generate significant value and benefit the grid-scale energy storage market.

What's Next

Siting BESS can be challenging based on the location of the facility. Permitting requirements vary widely from state to state, and within each state when permitted at the local County and Township level. Siting activities involve many multi-disciplinary services including surface water delineations, ecological assessments, cultural resource surveys, surveying, transportation studies, decommissioning plans, civil and geotechnical engineering, zoning and planning commission reviews, and public and community relations. Ohio recently approved its [first grid-connected BESS] in an area that is home to several large technology company data centers and the future home of Intel's newest semiconductor facility.

Ohio Power Siting Board (OPSB) approves of Eolian's Flint Grid Battery Energy Storage System (BESS) Project, the first standalone BESS approved by OPSB

Please contact us if you have any questions about battery storage. We will connect you with one of our experts who can help. With full-service teams, Verdantas can deliver the resources necessary to plan, permit, design, and construct projects for a range of clients including developers, private industry and government agencies.

Sources

International Energy Agency, September 2022, "Grid-Scale Storage", https://www.iea.org/reports/grid-scale-storage

United States Environmental Protection Agency, November 1, 2022, "Electricity Storage", https://www.epa.gov/energy/electricity-storage

Center for Sustainable Systems, University of Michigan. 2021. "U.S. Energy Storage Factsheet." Pub. No. CSS15-17.