Energy Storage Association

storagePLUS

Energy Efficiency

Energy storage systems introduce increased flexibility into the electric grid. Storage enables other technologies, creates new and broader opportunities for a cleaner supply mix, and increases the effectiveness of other energy resources, such as energy efficiency.

Energy storage systems allow the grid to run more efficiently while also mitigating the need to build, install, and operate other more resource-intensive infrastructure. Deploying energy efficiency and energy storage resources in tandem at a range of scales—from a transmission grid down to an individual building—can yield more cost-effective results. Conversely, retrofitting a commercial building or other system that already incorporates energy efficiency with an energy storage component can optimize the existing resource. *For an example of this optimization potential, check out ESA's Spotlight on Storage blog post covering a recent innovative thermal energy storage technology announcement.*

Lastly, thermal energy storage can also be a form of energy efficiency, and when thought of as such may reveal additional use cases and applications for the owner/operator to explore.

Storage + Efficiency in Comprehensive Energy Planning

Holistic energy system planning at any scale can benefit from the integration of both energy efficiency and energy storage resources. This applies just as much to designing a building or campus as it does to planning future grid-connected resources. Storage and efficiency together produce several synergistic benefits that should be planned for in tandem.

Together with efficiency, energy storage can be an effective way to reduce demand charges for businesses (and certain residences) whose electricity tariff includes a price for their peak demand. Peak load shifting is an ideal use case for energy storage systems, which can facilitate businesses avoiding higher peak demand charges. This application couples well with energy efficiency improvements, ensuring that the equipment contributing to demand peaks is as efficient as possible to begin with further mitigates higher energy consumption and the charges that result.

When planning a facility with on-site generation, energy storage and efficiency can together reduce the size and expense of the electricity generation system. Energy efficiency reduces the total energy use of a facility while energy storage is highly effective at reducing the peak loads during periods of high demand. Without storage, on-site generation would have to be sized to meet these peaks, or otherwise require the facility to purchase electricity from the grid, often times at peak rates.

Many programs to support cleaner and more efficient energy choices are now adding energy storage as an eligible technology. For example, the 2018 Farm Bill[i] added energy storage as an eligible technology to the Rural Energy Savings Program that supports loans for energy efficiency projects on farms and in rural small businesses.

Storage Enabling Efficient Right-Sizing

More directly for storage plus efficiency, the deployment of energy storage systems on an electrical grid or in a facility can significantly improve operating efficiency. Generation, transmission, and distribution must be built to meet the demands of the highest load a region is likely to encounter, which means that most of the time, systems are overbuilt with more capacity than needed. Siting energy storage on a grid—particularly close to load (thus avoiding peak period constraints on transmission), can dampen the peak demands and shift loads to off-peak periods.

Storage is an ideal resource for ancillary services[ii] given the rapid ramp-up rates and because the output from, and input to, most storage resources can be varied rapidly, making them more responsive and flexible as ancillary services resources than conventional generation. Typically, some conventional generation is kept as 'spinning reserve': the power plant is running idle, or spinning, and ready to respond at short notice to meet power quality issues or sudden changes in demand. While in standby mode, the conventional generation spinning reserve burns fuel but does not export power; conversely, energy storage can fulfill much the same role without burning fuel. Furthermore, the transmission and distribution voltage closer to a generation resource is often kept comparably high (with efficiency costs of doing so) in order to ensure that as voltage drops along a long line it is still high enough at its furthest distance. Siting energy storage along such a line to support voltage closer to the transmission or distribution line's end can reduce the need for higher voltages upstream, and thus save energy and money. The benefit of using storage to meet these needs is a reduced cost relative to generation-based ancillary services, including reduced need for generation capacity (equipment), and reduced generation operations costs for fuel, maintenance, and wear.

On the transmission side, energy storage can be used to reduce peak loads on power lines, preventing the inefficient overloading of transmission and distribution, or reducing the need to build additional lines to meet demand (and thus saving the energy required to build them).

In much the same way, energy storage systems (particularly thermal storage) can be used to reduce the size of a building's heating, ventilation, and air conditioning (HVAC) systems. Thermal storage systems can produce, for example, ice at night to be used to cool air during the day, thus reducing the size of required chiller units, condensers, etc. These smaller units will tend to be more efficient to operate. Total energy use across the course of a day may be greater on a net basis, but the congested grid and potentially higher energy prices (if on a time-of-use rate[iii]) will benefit from the reduced peak.

Conclusion

Energy storage and energy efficiency are key parts of a comprehensive and well-designed energy system at all scales. Planning for both types of resources can allow for cost and energy savings elsewhere, for example in transmission capacity build-outs or in commercial building HVAC systems. While integrating storage and energy efficiency resources into a system design from the outset will help you realize avoided costs to a greater degree, storage resources can be deployed at a later date to enable and optimize existing energy efficiency assets.

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[i] The Agricultural Improvement Act of 2018 (the "Farm Bill") was signed by the President on December 20, 2018. Among a wide range of provisions covering food, agriculture, rural communities, and other issues, this expansive bill includes provisions that add energy storage systems to existing rural energy programs.

[ii] Storage used for frequency response monitors the alternating current electricity frequency and responds to anomalies, over timeframes of milliseconds. The objective is to keep the frequency as close to the target frequency – 60 cycles per second in the United States – as possible.

[iii] Under a time of use rate, instead of paying a flat price for electricity, the price varies to correspond to the wholesale prices, either in tiers or dynamically. It encourages consumers to reduce use when wholesale prices are high, and shift use to off-peak periods when prices are lower.