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Energy Storage in PJM: A Perspective

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PJM Interconnection has long recognized the unique value of energy storage technology, welcomed its development, and is working to make sure that storage can become an integral part of a more reliable, cost-efficient grid with ever-more renewable resources.

We have always embraced the philosophy that inspired the U.S. Energy Policy Act in 1992, which opened access and competition in the wholesale electricity markets, encouraging new technology and innovation.

PJM's markets have proven to be a ready platform for innovative storage resources, and the approximately 300 MW of battery storage capacity in PJM is evidence of that. Some of the earliest storage resources found a home in the PJM markets, from pumped hydro to lithium-ion batteries to vehicle-to-grid technology, and the partnerships PJM has pioneered have informed federal regulators' opening of the markets to new storage technologies.

The process of integrating batteries into the markets has not been without challenges. PJM has worked with all stakeholders to ensure that we capture the value of this promising new technology in a way that is fair and nondiscriminatory.

Opening Markets

In any future electric grid dominated by renewables, ***energy storage helps to balance the nature of renewable resources whose output can vary.*** Tech companies and energy developers are working ***to produce batteries with greater storage capacity that can function similar to traditional generators.*** Currently, batteries fill a valuable niche role, providing frequency regulation in PJM's Ancillary Services Market, in order to help maintain system stability.

Looking forward, PJM's queue of new planned generation includes approximately 2,000 MW of stand-alone energy storage and 4,000 MW of resources that package together both energy storage infrastructure and renewable resources.

This level of interest serves as a clear indication that the PJM markets are attracting new, innovative clean-energy resources and that the opportunities for energy storage through the PJM market are growing. ***The economic signal being sent by PJM's system needs will spur the market to develop longer-duration batteries.*** In fact, we already are seeing the development of those technologies.

Storage developers are also finding ways to meet PJM requirements through aggregation, combining with other resources, or providing additional revenue streams through "value-stacking."

In value stacking, an energy storage resource provides benefits both at the wholesale level, through the PJM market, and at the local level, such as by reducing loading on a local substation or providing emergency backup to an end-use customer.

The Village of Minster, Ohio, uses value-stacking to tap into multiple revenue streams through the deployment of solar panels and battery storage. The solar-plus-storage system has helped reduce demand – and therefore costs – during peak demand, when prices are high, enabling the Village to defer expensive

equipment upgrades while also selling grid support services into the PJM frequency response market.

FERC Order Calls for Full Participation

The Federal Energy Regulatory Commission recognizes the importance of storage technology. Last year **FERC issued Order No. 841**, which **requires PJM and all regional organizations that manage the nation's electric grids to remove barriers to participation for energy storage resources in the wholesale electricity markets.**

As FERC seeks to level the playing field to include energy storage, PJM already is substantially compliant with two of the **four requirements in Order 841**, specifically:

- **Energy storage resources already have full access to PJM's technology-neutral Energy, capacity and Ancillary Services markets. Batteries represent, on average, more than 80 percent of fast-responding frequency regulation resources.**
- PJM has already established a **low size threshold of 100 kilowatts for all resources (including energy storage) to participate in the wholesale markets.**

PJM has proposed enhancing its market rules to meet the remaining two elements of the order:

- **Energy storage resources can be dispatched by the grid operator and can set the wholesale market clearing price as buyers (they can already do this as sellers).**
- PJM's proposal gives energy storage operators new tools to participate in markets while accounting **for the physical and operational characteristics of their resources, including fast ramp times, the ability to quickly switch between charging and discharging states, and range of state of charge between charging and discharging states and continuous mode.**

As part of our Order No. 841 filing to FERC, we clarified established rules on how storage resources, including batteries, **can participate in PJM's capacity market. These resources must be available to provide energy when needed in system emergencies.** This is consistent with **FERC's requirement that markets be resource-neutral and open to participation by batteries – or any other resource – according to its "technical capability" to provide the service in question.**

Today, ***in PJM and in other areas of the country, battery duration is generally limited to anywhere from 15 minutes to four hours at its rated capacity before it needs to be recharged.*** We don't exclude these batteries from participating in the capacity market. PJM has analyzed its reliability requirements and determined that the electricity demand of customers during a peak summer day spans a 10-hour period.

The 10-hour duration requirement does not mean that an energy storage resource such as a battery is required to run at full output for 10 hours in order to be considered a capacity resource. Rather, the resource can offer any capacity value up to the quantity it can produce for 10 continuous hours, just like other capacity resources including pumped storage hydro, demand response, nuclear, gas and coal. ***Batteries also have the flexibility to bid into the capacity market by aggregating with other resource types,*** such as other storage, demand response, wind, solar or energy efficiency resources.

High Standards Spur Innovation

If you set appropriate standards in a fair market, people and companies find innovative ways to achieve them. We've seen this concept play out time and again, most recently in the last capacity auction.

As we continue to look for new ways to deploy energy storage, we are seeking to work with policymakers and stakeholders on other innovative ways to incorporate these resources, such as deploying energy storage as transmission assets in specific cases to avoid the need for new transmission lines, or in pairing them with other generation resources such as wind or solar

As PJM [testified](#) to the U.S. Senate Committee and Energy and Natural Resources in June, energy storage technologies "can be designed, deployed and controlled in such a way that they can provide multiple different services and reliability needs across the electric power sector: generation, transmission, distribution, all the way down to the residential customer." Innovation, equal access to the transmission system and fair markets lead to a more resilient, affordable grid – and that's good for customers, the industry and the country.