

U.S. Senate Committee on Energy and Natural Resources
June 4, 2019 Hearing
Opportunities for the Expanded Deployment of Grid-Scale Storage in the United States
Questions for the Record Submitted to Mr. Andrew Ott

Questions from Chairman Lisa Murkowski

Question 1: One of the benefits of energy storage resources is their ability to store power when it is generated – often when the power is the least expensive – and dispatch that power during periods of peak demand. How does this ability to serve as a peaking resource ultimately lower energy costs for consumers?

PJM Response:

Serving as a peak power resource, energy storage has the potential to lower the cost of electric service for consumers primarily in two ways. First, deploying energy storage resources can lower the cost of energy during peak times if the cost of storing energy during off-peak times and discharging that energy to the grid during on-peak times (plus any losses) is cheaper than the incremental cost of dispatching a thermal power plant during on-peak times. For example, if an energy storage resource charged or pumped at night at a cost of \$20/MWh and was willing to return that energy to the grid at \$35/MWh, it would be cheaper to use that resource during a peak hour than to dispatch a \$36/MWh unit to serve that same increment of load. This is a simplistic example to illustrate the point. In reality, physical constraints in the transmission network can affect which units are dispatched to serve load during peak times, which could result in the storage resource (or any resource) not being dispatched despite it being more cost effective. Moreover, the degree to which energy storage resources can be used to provide energy relates to their duration before needing to recharge, an issue highlighted in Mr. Ott's testimony.

Second, energy storage resources that have the duration to provide energy over a peak period can be valued for the resource adequacy they contribute to the system. In PJM, resource adequacy is valued through a capacity market, called the Reliability Pricing Model. Energy storage resources that offer and clear in the PJM capacity market may be less expensive than another resource offering into that market, and therefore can provide savings or downward pressure on future capacity costs for consumers. To date, hydro facilities are candidates for serving as capacity resources, although PJM would similarly accept any storage resource that can meet the FERC-approved capacity obligations needed to ensure a reliable system. PJM looks forward to FERC's ruling on the aggregation of distributed energy storage resources, as aggregation may be another means for energy storage resources to qualify as capacity resources in the PJM market.

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These are ways in which energy storage as a peaking resource could lower energy costs for consumers at the wholesale level, affecting all or a multitude of consumers across a wide area. It should be noted that in addition, there are individual customer-level benefits that energy storage can provide at the distribution level. The opportunities for energy storage at the distribution level are highly dependent on the state-regulated distribution tariff under which a customer takes electric service from the utility, or ways in which the distribution utility itself can use storage as a peaking resource to lower their costs to reliably serve consumers.

Question 2: PJM is the largest wholesale market in the country, serving 65 million people from Chicago to the Atlantic Coast. What are some of the challenges of incorporating energy storage into such a large market? What benefits do you expect to see as the grid continues to add more energy storage?

PJM Response:

The size of the PJM market has actually provided benefits in terms of more efficient dispatch, market settlement and interconnection of energy storage resources. Nevertheless, the competitiveness of the markets in PJM today may create challenges for storage development. The PJM Energy Market has been producing historically low prices in recent years, largely due to the exit of older, less-efficient power plants and the influx of new, highly efficient and lower-cost natural gas plants, as well as renewable resources.

Energy storage resources clearly have the ability to increase the utilization of existing generation and transmission assets on a system-wide basis. As a result, benefits may include more efficient dispatch of generation and the potential for lower costs and lower emissions. Widespread deployment of energy storage may also have the ability to reduce losses on the transmission system or distribution system, depending on the energy storage resource's location and utilization. Finally, flexible resources such as batteries can help with the challenges of balancing fluctuations in demand for electricity and, increasingly, fluctuations in variable wind and solar output. These fluctuations are most impactful in smaller markets with extensive wind and solar deployment and less fossil resources available to help manage those fluctuations. Nevertheless, these issues exist in the PJM market as well and will increase over time as more renewable resources are deployed. It is for this reason that PJM has sought to more appropriately

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value resources held in reserve as specified in our Enhanced Price Formation in Reserve Markets filing in Docket No. EL19-58-000, now pending before the FERC.

As noted in Mr. Ott's testimony, today's limited duration of batteries does limit the ability of PJM to treat and compensate these resources as capacity the same as fossil resources or demand response resources that are available upon call. We look forward to continued technological development in this area. In the interim, PJM will continue to still provide these resources with credit for the amount of capacity they would be able to provide just as PJM does today with renewable resources.

Question from Senator Angus S. King, Jr.

Question: Pumped storage and batteries generally have high capital costs and low operating costs. Current financing drives investors and development towards low capital cost investments like natural gas. Can you expand on potential mechanisms to help develop capital intensive applications like pumped storage and batteries, such as long-term contracting?

PJM Response:

By operating a forward capacity market, the PJM markets send a reliable investment signal as to the costs and opportunities for financing new technologies in the PJM markets. In addition, while the markets that PJM operates are generally hourly in nature, (except for capacity which is an annual commitment), there is nothing that impedes generators from contracting bilaterally with load or financial markets under longer-term agreements. In fact, long-term contracts are common in PJM and, indeed, are an implicit goal of the design for the spot markets that PJM administers – transparent spot market pricing from the PJM markets generally serves as a reference point for such contracts.

In the past, PJM stakeholders have discussed longer-term market products (e.g., multi-year) but the credit requirements associated with longer-term forward positions in the market have been a formidable barrier to stakeholder acceptance. Several policy initiatives that Mr. Ott summarized in his testimony and which are still awaiting decision at FERC should enhance the options for capital-intensive technologies such as energy storage. Specifically, PJM's Enhanced Price Formation in Reserve Markets filing (Docket No. EL19-58-000) is an important market design enhancement that will improve energy-reserve price

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formation, thereby sending more accurate market signals that reflect the value of reliability and mitigate the missing money problem that has impeded efficient investments in capital-intensive applications.