POLICY BRIEF: New ESA-NRDC Study Refutes PJM Proposal to Limit Storage Capacity Market Participation in FERC Order 841 Compliance Plan

July 2019

FERC Order 841 requires regional electric market operators to enable the use of energy storage on the grid to provide services for which it is technically capable. One of these operators, PJM, has requested a special rule that would effectively prevent a number of storage projects from market participation and is based on flawed assumptions.

As part of our FERC filings, the U.S. Energy Storage Association (ESA) and National Resources Defense Council (NRDC) commissioned a study by Astrapé Consulting that provides evidence and supporting data that refutes PJM's arguments about capacity limitations, supporting our arguments that FERC should decline PJM's request.

READ THE FULL ESA-NRDC STUDY ON CAPACITY VALUE OF STORAGE IN PJM >>

Why did ESA commission this study?

In many eastern states, regional electric market operators – such as PJM Interconnection in the mid-Atlantic, New York ISO, and ISO New England – determine how much available supply is needed on standby to maintain reliable electric service (a service known as "Capacity"). PJM, NYISO, and ISO-NE then run markets where power plant owners bid for payments to provide Capacity service at specified points in the future. Winners of those bids get a reliable future revenue stream that can ensure profitability for many power plants.

Energy storage projects, particularly batteries, are being installed on electric grids across the country to make electric service more affordable, reliable, and sustainable. However, regional electric markets were designed prior to the widespread availability of cost-effective energy storage, and so the rules for Capacity service were generally not designed with energy storage in mind.

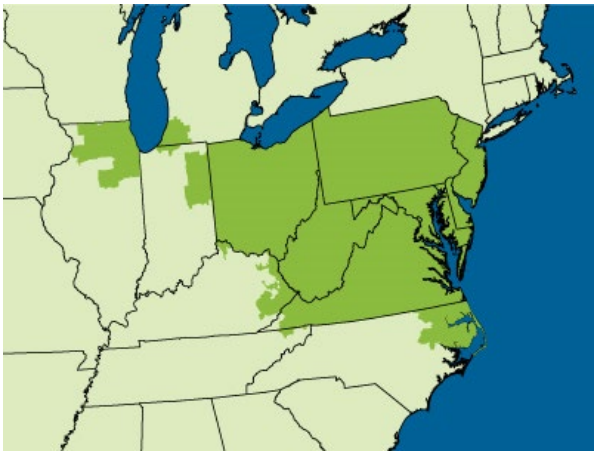
Energy storage is unique from other resources in two key ways—storage is more highly controllable than any power plant, and storage can only provide output until it runs out of "charge." This is why the Federal Energy Regulatory Commission (FERC) issued Order 841, a set of directives to regional market operators like PJM to allow energy storage to participate in all markets of which it is technically capable,

including Capacity markets, and to do so in a manner that reflects the physical and operational characteristics of energy storage.

PJM filed a compliance plan with FERC that proposed a special rule for energy storage in Capacity markets: it would qualify the storage at the level of output that can be sustained over 10 hours. ESA and other stakeholders filed complaints at FERC to this proposal. We argued that a 10-hour rule would unreasonably restrict access to the market for many storage projects. Our complaint noted that PJM's proposal was not well-grounded in analysis on the actual Capacity value of energy storage and ran counter to PJM's own Capacity market's existing rules (for further info, read ESA's original complaint here). Indeed, a dispute followed in which PJM argued that ESA did not have evidence on the Capacity value of energy storage.

ESA, in conjunction with NRDC, responded by commissioning a study from Astrapé Consulting to determine the Capacity value of energy storage projects in the PJM regional market's territory, based on the recent operations of PJM's system. That report was filed with FERC as part of our complaint, and ESA is pleased to release the final report in full today. It concludes that shorter duration storage is sufficient to ensure reliability and merits full Capacity value for the foreseeable future.

Figure 1. Map of the PJM Regional Electricity Market



Why does this matter?

Nearly all Capacity market payments go to coal, natural gas, and nuclear power plants. Access to Capacity payments has recently become a hot-button political issue, with gas-fired power plants winning ever larger shares of Capacity payments and operators of some nuclear plants arguing that lack of such payments will force their units to retire. Overdependence on fuel-based power plants in Capacity markets, moreover, can squeeze out competition from clean energy sources like wind and solar. On the other hand, adding more storage makes an ideal, carbon-free partner to renewable resources.

Energy storage offers both the option of being highly cost-effective and reducing carbon pollution. Whereas many fuel-based generators run for only tens or maybe hundreds of hours per year to meet peak system demands, energy storage units can operate regularly throughout the year without much cost since they don't burn any fuel (and can even be helpful sinks for periods of over-supply). At the same time, energy storage helps integrate larger shares of variable wind and solar power, and so can accelerate the carbon reductions from renewable energy deployment.

Capacity markets that inappropriately exclude or undervalue energy storage, therefore, can force higher than needed payments for Capacity—which ultimately translates into higher electric bills for customers—and can limit the carbon pollution reductions from the deployment of renewable energy.

How much does energy storage contribute to system reliability in PJM?

At the heart of ESA's dispute with PJM is what amount and duration of energy storage projects that can provide the same Capacity value as fuel-based power plants?

Various supply resources have different constraints and vulnerabilities that affect their Capacity service reliability. The main constraint of energy storage is its limited runtime before needing to recharge. For fuel-based generators, often the main constraint is outage due to physical wear & tear and maintenance needs. Other sporadic issues, such as very high temperature days, can also limit their operations. Wind and solar power plants have variable generation that depends on environmental conditions, and hydropower plants can experience low reservoirs due to rainfall.

Capacity markets should theoretically seek "reliability-agnostic" service by fashioning rules intended to make these diverse resources effectively equivalent. PJM has indicated they believe storage must run continuously for 10 hours to provide equivalent Capacity service as conventional power plants—a stringent requirement that no other market has proposed.

The study calculates the reliability of the PJM grid with varying scenarios of storage added, using the actual supply resources and demands of the PJM system observed over the last several years. The model that Astrapé Consulting employed is the same model used to calculate Capacity needs by regional market operators like MISO, SPP, and ERCOT, and utilities like Southern Company, Duke Energy, and Tennessee Valley Authority.

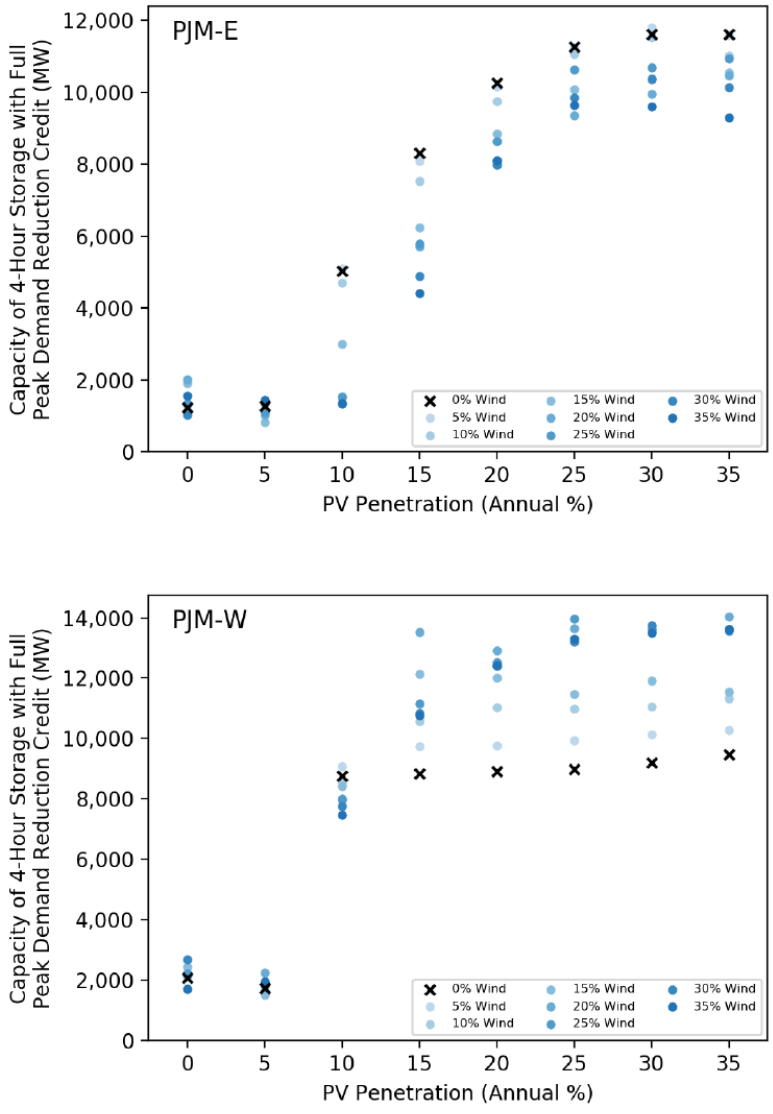
What the study found is that over 4,000 MW of new 4-hour storage and over 8,000 MW of new 6-hour storage would provide the same reliability as conventional power plants today. The reason for this is that the peak demands of PJM's system can presently be met by efficient dispatch of shorter-duration storage, given the current mix of supply resources. As shares of storage increase to particularly high levels, longer durations become more valuable than shorter durations.

Figure 2. Capacity Value of Storage in PJM Under Varying Durations and Penetrations

Duration (Hours)	Penetration (MW)	Capacity Displaced (MW)	Capacity Value (%)
2	1,000	1,000	100.00
2	2,000	2,000	100.00
4	1,000	1,000	100.00
4	2,000	2,000	100.00
4	4,000	3,996	99.90
4	8,000	7,648	95.60
6	1,000	1,000	100.00
6	2,000	2,000	100.00
6	4,000	4,000	100.00
6	8,000	8,000	100.00
6	10,000	9,789	97.89
6	12,000	11,200	93.33

That said, this study did not look forward at potential changes to the supply mix as, for example, more wind and solar power is added to the system. A recent study by the National Renewable Energy Laboratory shows that shorter-duration storage may retain Capacity value as more renewables come online, due to the shorter duration of peaks on an electric system with lots of wind and solar power.

Figure 3. Capacity Value of 4-Hour Storage in PJM-East and PJM-West Under Varying Levels of Renewable Energy (Source: NREL)



Indeed, this is why other regional market operators like NYISO recently proposed to FERC to assign nearly full Capacity value to 4-hour storage and full Capacity value to 6-hour storage, while also recognizing that that Capacity value likely need to be revisited as the mix of supply resources on the system changes over time.

Studies are well and good, but would storage have performed during actual peak demands on PJM's system?

ESA's own analysis has found that during PJM's most stressed peak days, many conventional power plants failed in actual operations to meet the 10-hour requirement that PJM proposes for storage. Looking at publicly available data from actual power plant operations (i.e., CEMS data collected by the EPA), we assessed the duration required of each power plant on these peak days to maintain the PJM system's reliability. On each of those days, we grouped the PJM fuel-based power plant fleet into three categories: those that did not run at all; those that generated output that a 4-hour storage unit could provide; and those that generated output greater than a 4-hour storage unit could provide. The results are presented in Figure 1. During the days of highest stresses on the grid—ostensibly the basis for PJM's 10-hour requirement—18,000 MW to 36,000 MW of power plant capacity either did not run or generated output that a 4-hour storage unit could provide.

Figure 4. PJM Fuel-Based Power Plant Performance During Recent Highest Peak Demand Days

Significance	*Polar vortex day, longest PJM performance period since at least 2011*	*Second most recent PJM performance period*	*Most recent PJM performance period*	*All time high winter peak in PJM*	*Winter peak 2018*	*Summer peak 2018*
Date	1/7/2014	1/30/2014	3/4/2014	2/20/2015	1/5/2018	8/28/2018
MW of power plant capacity that did not run	**12,372**	**18,033**	**22,029**	**12,963**	**13,017**	**8,983**
MW of power plant capacity that ran, but output was less than 4-hr storage equivalent	**8,062**	**15,004**	**14,756**	**9,448**	**5,675**	**11,849**
Total MW of power plant capacity with output less than 4-hr storage equivalent	**20,434**	**33,037**	**36,785**	**22,411**	**18,693**	**20,831**

Under PJM's current rules, these 18,000 to 36,000 MW power plants are still eligible to offer their full rated power and receive proportional revenues in PJM's Capacity market. On the other hand, under PJM's proposed 10-hour requirement for storage, a 4-hour energy storage project capable of providing the same level of Capacity service would be limited to offering only 40% of its rated power and thus receiving 40% of Capacity payments.

What happens now?

This analysis is now before FERC, along with ESA's arguments that PJM is inappropriately trying to advance a rule that violates Order 841 and would contradict its own Capacity market design that FERC previously approved. Ultimately, it is up to FERC to adjudicate the present dispute and determine the extent to which storage will be allowed to offer its full contributions and compete with fuel-based power plants to provide Capacity service in PJM.

Nonetheless, the issue of the Capacity value of energy storage will remain a debated topic for much time to come. ESA looks forward to working with FERC, market operators, and other stakeholders to ensure that storage is managed fairly.