



# CRA Insights: Energy

**CRA** Charles River  
Associates

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## Order No. 841 – Planning for next steps

In this *CRA Insights* piece, we provide an update on the emerging wholesale market opportunities for energy storage now that significant progress has been achieved by FERC and the ISOs in establishing new wholesale market tariffs for energy storage resources. We review progress to date on new markets, proposed tariff changes, and remaining compliance requirements. Finally, we offer our perspective on immediate next steps for those planning for market entry. For those tracking new market opportunities in energy storage, such as merchant developers and utilities, this piece provides timely insights and updates as to potential new market opportunities.

### Background

In February 2018, the Federal Energy Regulatory Commission (FERC) issued a landmark order for energy storage, Order No. 841<sup>1</sup> (Order), which established standards for energy storage participation in wholesale markets. Each of the six independent system operators (ISOs)<sup>2</sup> filed initial tariff proposals in December 2018 to establish market compliant rules. As of December 2019, FERC has issued initial compliance orders on all filings (the most recent order for NYISO was issued on December 20, 2019).<sup>3</sup> We believe that sufficient clarity of market rules and wholesale tariffs now exist to provide merchant generation, utilities, and other asset owners or investors a clearer planning path to new opportunities in wholesale markets. Now is the time to begin planning for market entry as we believe final tariff approval and implementation across all ISO markets can occur within the next 24-36 months, with the expectation that some markets may open sooner.

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<sup>1</sup> Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, Order No. 841, 162 FERC ¶ 61,127 (2018).

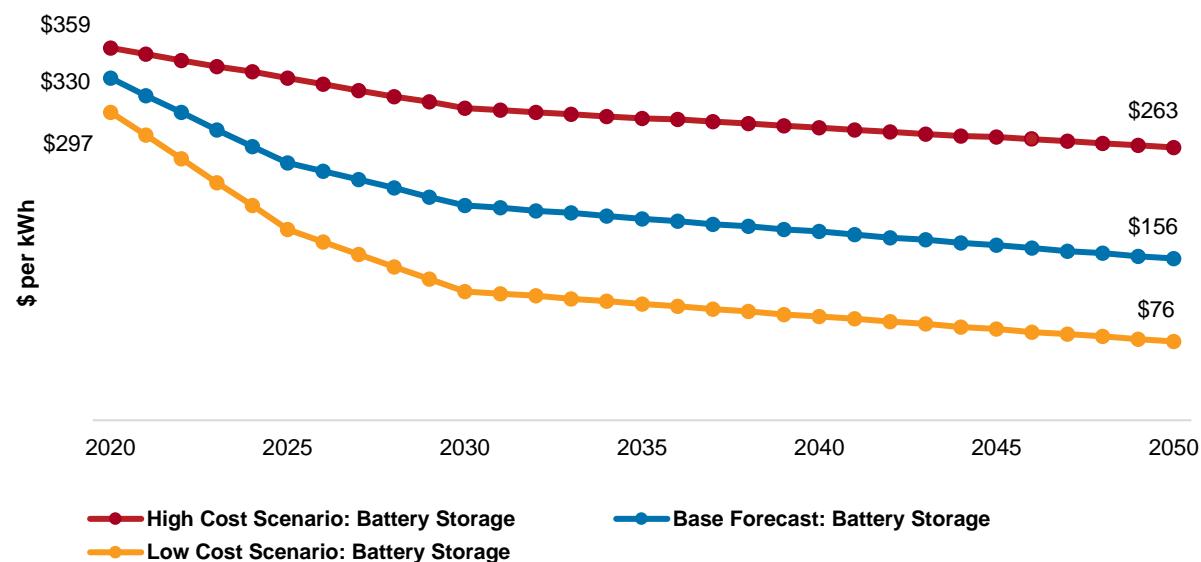
<sup>2</sup> PJM Interconnection (PJM), California ISO (CAISO), ISO-New England (ISO-NE), New York ISO (NYISO), Southwest Power Pool (SPP), and Midcontinent ISO (MISO).

<sup>3</sup> Order on Compliance Filing re New York Independent System Operator, Inc., Docket No. ER19-467-000, 169 FERC ¶ 61,225 (2019).

## Why Order No. 841 now?

Battery component prices are steadily falling, and forecasters expect continued declines. Recent projections from the National Renewable Energy Laboratory are shown below.

**Figure 1: Projected overnight capital costs for a lithium-ion battery plant, 2020-2050<sup>4</sup>**



In recent periods, industry activity and investment in battery storage has increased as utilities and other investors become more comfortable with the economics and operating versatility of battery storage. For instance, multiple utilities across the country are already investing in larger scale energy storage resources. Florida Power & Light is planning to use lithium-ion battery storage and photovoltaic solar to replace two natural gas-fired plants in Parrish, Florida. The Manatee Energy Storage Center will consist of a 409 MW battery charged by an existing co-located solar plant. The battery will shift solar resource to peak hours after sunset when it is needed most.<sup>5</sup> Southern California Edison recently abandoned plans to build a 262 MW natural gas plant and instead opted for a 100 MW / 400 MWh battery facility in Oxnard, California.<sup>6</sup> Regulators in New York identified 275 MW of gas plants as candidates for replacement with storage facilities.<sup>7</sup> The state's public service commission is considering up to 316 MW of lithium-ion battery storage to replace 16 natural gas-fired units at the Ravenswood Generating Station in Long Island by 2021.<sup>8</sup>

<sup>4</sup> Cole and Frazier, "Cost Projections for Utility-Scale Battery Storage," National Renewable Energy Laboratory, June 2019.

<sup>5</sup> Florida Power & Light, "FPL Announces Plan to Build the World's Largest Solar-Powered Battery and Drive Accelerated Retirement of Fossil Fuel Generation," news release, March 28, 2019.

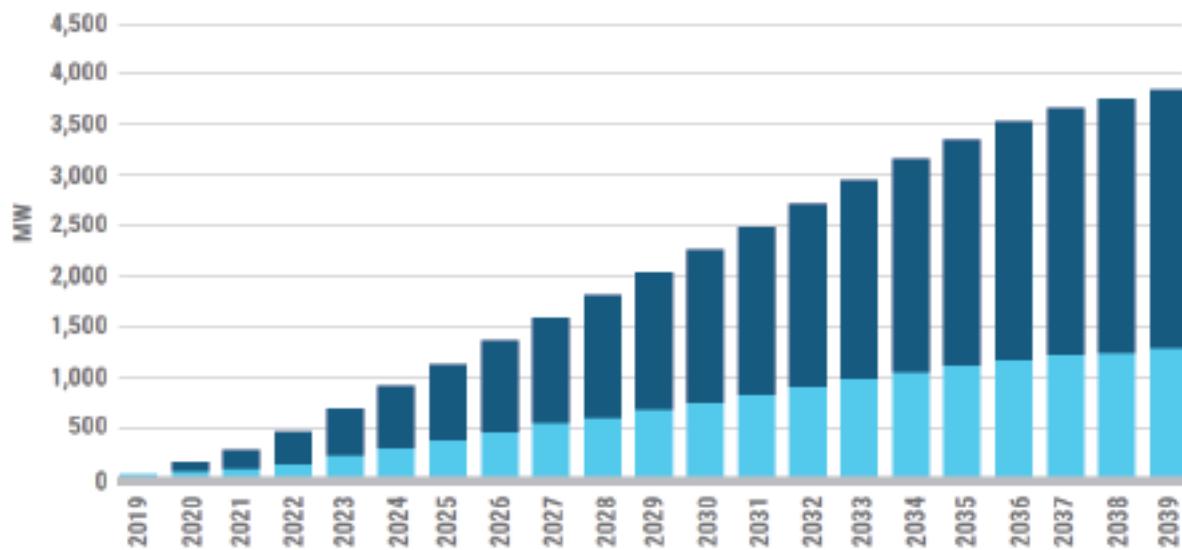
<sup>6</sup> Spector, J., "SCE Picks Major Battery Portfolio in Place of Puente Gas Plant," Greentech Media, April 25, 2019.

<sup>7</sup> Mai, H.J., "New York Regulators Assess Potential for Storage to Replace Peaking Units," Utility Dive, July 3, 2019.

<sup>8</sup> Institute for Energy Economics and Financial Analysis, "New York Moves Forward with Plans to Use Battery Storage to Replace Natural Gas Peakers," September 17, 2019.

Further, the NYISO forecasts nearly 4 GW of grid-connected and behind-the-meter storage resources installed by 2039 in its Power Trends 2019 report.

**Figure 2: New York energy storage capacity forecast, 2019-2039<sup>9</sup>**



These new, projected, or proposed investments are impressive and represent new approaches to addressing needs behind the meter and in front. We believe that now – with the Order – new wholesale tariffs will help expedite access to wholesale markets.

Final tariffs compliant with the Order will allow equitable market access for energy storage as compared to traditional resources in capacity, energy, and ancillary service markets. CRA believes these tariff changes will help maintain the current trajectory for new energy storage investment.

### What change was needed?

Despite the improving economic and technical capabilities associated with energy storage, particularly for battery storage, tariff rules governing the participation of energy storage resources did not exist in all ISO tariffs. The CAISO tariff supports an existing “non-generator resource” (NGR) participation model, implemented in 2011, which allows energy storage resources (ESRs) to participate in its wholesale markets. While CAISO pointed out in its proposed tariff filing that the NGR model is “equivalent to Order No. 841’s [ESR] participation model,”<sup>10</sup> it has proposed separate participation models for pumped hydropower resources and aggregated behind-the-meter storage resources (such as residential battery storage) in its filing to better accommodate battery storage characteristics. ISO-NE proposes to expand its existing platforms that allow pumped hydropower storage resources to participate in its wholesale markets by including fast-start storage resources in its participation models.

<sup>9</sup> The New York ISO Annual Grid & Markets Report: Reliability and a Greener Grid, Power Trends 2019.

<sup>10</sup> California Independent System Operator, “Compliance with Order No. 841,” December 2, 2018.

In its initial tariff filing, PJM proposes to modify its definitions of “Storage Resource” and “Capacity Resource” to accommodate battery storage in its footprint.

## **What are the new rules? Uniform standards and ISO-specific approaches**

Order No. 841 established the following five requirements for wholesale market participation models. Specifically, energy storage resources must be able to:

1. Provide capacity, energy, and ancillary services that the resource is technically capable of providing;
2. Be dispatched and able to set the wholesale market price as both a buyer and seller of energy;
3. Account for their physical and operational characteristics through bidding rules;
4. Establish a minimum size requirement of not more than 100 kW; and,
5. Be compensated for sales transactions from the ISO/RTO that are then resold at locational marginal price.

Consistent with precedent, FERC granted each ISO latitude to create rules specific to the unique characteristics of the ISO’s own energy, capacity, and ancillary services markets. Accordingly, initial tariff filings reflect a variety of approaches to comply with the same requirements. The array of different implementation approaches to address these requirements provides opportunities for, and indeed necessitates, market participants to evaluate each ISO market and proposed tariff individually and assess the trade-offs of each. For instance, PJM’s original filing proposed a minimum 10-hour duration requirement for an energy storage resource to participate in its capacity market to align the requirement with the length of customer peak demand during a typical peak summer day.<sup>11</sup> In contrast, MISO proposed a minimum duration of 4 hours, and ISO-NE proposed 2 hours. A shorter minimum run-time provides resources opportunities for capacity market participation at a higher capacity commitment as compared to what could be marketed in an ISO with longer duration requirements. This is just one example of many variations in tariff implementation to tariff implementation that we observe across the filings. In addition, differences in proposed structures for market participation models, bidding and operational characteristics, and other features exist across the ISO proposals.

CRA has summarized the tariff modifications proposed by each ISO in the following table:<sup>12</sup>

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<sup>11</sup> PJM Interconnection, LLC. Answer of PJM Interconnection, L.L.C. to Protests and Comments, FERC Docket No. ER19-469-000. March 5, 2019.

<sup>12</sup> Note, this table represents a sample of rule variants contained in the ISO initial filings for illustration purposes.

**Table 1: Tariff modifications proposed by ISOs**

	Participation Model	Participation in RTO/ISO markets	Bidding Parameters	Energy Transactions
CAISO	Behind-the-meter storage; aggregation; grid-scale, non-hydropower storage; and pumped hydropower storage are all eligible	Capacity: 4-hour resource adequacy minimum run-time  Ancillary Service (AS): Regulation service (only grid-scale, non-hydropower storage)  Energy: Buy and sell into market at wholesale locational marginal price	Resources include capacity max and ramp times for the CAISO to optimize; or,  CAISO also allows self-management for state of charge	Energy sales and purchases priced at LMP  No transmission charges
ISO-NE	Resources bid as continuous or binary models	Capacity: 2-hour minimum run-time  AS: Regulation service  Energy: Buy and sell into market at wholesale locational marginal price	ESRs will report five operational characteristics via telemetry, and ISO-New England will account for the other eight.	Energy sales and purchases priced at LMP  No transmission charges
MISO	Unique offer structure in Day-Ahead and Real-Time markets for resources; uses Commitment Status to signal availability	Capacity: 4-hour minimum run-time  AS: Regulation service, no transmission charges, Resource can operate in AS and Energy at same time, MISO will optimize output amongst AS and Energy markets.  Energy: Buy and sell into market at wholesale locational marginal price	MISO signals dispatch through 24 parameters  Dispatch reviewed by market monitor	Energy sales and purchases prices at LMP  Distribution-level resources must track charging and disclose any sales via retail rate  Transmission charges assessed on certain transactions
NYISO	Dispatch-only model with buy-out provision when output falls below dispatch range	Capacity: 4-hour minimum run-time  AS: Regulation service during both injection and withdrawal from the grid, NYISO will optimize output between AS and Energy markets  Energy: Buy and sell into market at wholesale locational marginal price	ESRs can operate in four modes: ISO-committed fixed, ISO-committed flexible, self-committed fixed, and self-committed flexible  Dispatch reviewed by market monitor	Bids to withdraw energy for later injection treated as negative injections rather than as withdrawals to serve load  Transmission charges are assessed to customers at the zonal level based on their energy withdrawals to serve load
PJM	Adapts existing storage resource participation model (pumped-hydro)  Storage can operate in one of three modes: continuous, charge, or discharge	Capacity: 10-hour minimum run-time  AS: Regulation service  Energy: Buy and sell into market at wholesale locational marginal price	Some characteristics are accounted for via data entered into Markets Gateway, while others are accounted for by submitted bidding parameters. Resource will self-schedule its state of charge	Wholesale purchases from PJM will occur at the LMP
SPP	Storage may participate as an existing resource type or under a new market storage resource (MSR) model exclusive to energy storage	Capacity: 4-hour resource adequacy minimum run-time  AS: Regulation service, SPP will optimize output between AS and Energy markets  Energy: Buy and sell into market at wholesale locational marginal price	SPP algorithm to accommodate priority order of resources in unit commitment. It will include charging and discharging limits  Resources to self-schedule for state of charge	All energy in Energy and Operating Reserve markets is settled at the LMP  No transmission charges but resources must request sufficient transmission service for charging activities

As Table 1 shows, each ISO has proposed somewhat different tariff and market rule approaches to address requirements of the Order. This implementation approach preserves each ISO's ability to propose rules that best fit their existing market structure and profile. Yet, each unique approach challenges investors to thoroughly evaluate their options.

### Full compliance to be achieved shortly

As of December 20, 2019, all ISOs received orders on compliance from FERC. Follow-up compliance issues are summarized as:

- **Operational Characteristics** – proposed tariff did not contain necessary detail or description of how resource characteristics would be accounted for in unit bid parameters;
- **Eligibility** – instances in which proposed eligibility requirements for resource participation in tariff were not consistent with Order standards;
- **Retail and Wholesale Participation** – proposed tariff did not sufficiently address or detail how retail and wholesale transactions would be separately tracked and managed;
- **Transmission Charges** – proposed tariff did not exempt certain energy transactions from transmission charges – contrary to standards in the Order; and,
- **Minimum Run-Time** – proposed tariff did not sufficiently address the support for minimum run-time requirement.

**Table 2: Compliance requirements on initial review**

Compliance Issue	CAISO	MISO	ISO-NE	NYISO	PJM	SPP
Tariff Effective Date*	12/3/2019	6/6/2022	12/3/2019	5/1/2020	12/3/2019	7/17/2020
Operating Characteristics	✓		✓	✓	✓	✓
Eligibility	✓					
Retail and Wholesale Participation	✓	✓	✓		✓	✓
Transmission Charges		✓		✓		
Minimum Run-Time			✓		✓	✓

\*Subject to final FERC compliance requirements.

Although each ISO has follow-up compliance requirements, CRA believes the remaining requirements will not present significant obstacles to full implementation along our anticipated timeline of complete implementation by mid-2022 (MISO, as the last to implement fully compliant tariff modifications). MISO requested and has received FERC approval for implementation in June 2022 to accommodate software complexities.<sup>13</sup> In a separate filing, MISO proposed an approach outside of ISO markets to

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<sup>13</sup> Midcontinent Independent System Operator, Request to Defer Effective Date of Compliance with Order No. 841, FERC Docket ER19-465-000, November 1, 2019.

compensate storage as a transmission-only asset (SATOA).<sup>14</sup> CRA consultants previously explored this option in a [recent article](#).<sup>15</sup> FERC has also opened separate Federal Power Act 206 proceedings to address minimum run-time in PJM<sup>16</sup> and SPP proposals.<sup>17</sup> PJM recently submitted (February 27, 2020) a motion to FERC requesting it hold the paper proceeding on minimum run-time in abeyance until January 29, 2021. PJM requested additional time to pursue a stakeholder process to evaluate whether a minimum run-time designation based on “effective load-carrying capacity” (ELCC) may be an appropriate alternative to the proposed 10-hour minimum.<sup>18</sup> On April 10, FERC granted PJM’s request in part, placing the requested dockets in abeyance until October 30, 2020.

## State utility regulatory action

On July 15, 2019, a coalition of state utility regulators and utilities petitioned the District of Columbia’s Court of Appeals to review Order No. 841. The state regulator group argued that the Order violates the Federal Power Act, which assigns FERC authority over wholesale markets, and state entities authority over retail transactions. The group alleges that if ISO tariffs allow aggregated behind-the-meter ESRs to participate in wholesale electricity markets, they would infringe on states’ rights to regulate a retail-only resource.<sup>19</sup> We anticipate that this complaint is likely to continue in the courts for a number of years during which time FERC will most likely move forward with implementation.<sup>20</sup>

## What does this all mean for investors seeking new opportunities?

The implementation of Order No. 841 will encourage investment as new markets open and those first movers who are successful in gaining early market share (while containing the risk of early adoption) may gain some advantage. Utilities, merchant developers, and other investors seeking new opportunity can begin evaluating market and investment decisions now that these rules are nearing approval. The principal challenge is to understand the complexities of the new rules and how they differ between market regions. Translating these differences into new opportunities and business models to support them will be the key success factor.

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<sup>14</sup> Midcontinent System Operator, Proposed Tariff Revisions for Storage as a Transmission Only Asset, FERC Docket ER20-588-000, December 12, 2019.

<sup>15</sup> Eryilmaz, D., Konidena, R., and Heilbrun, C., “[Energy storage as a transmission asset in regional markets](#),” *Law360*, January 22, 2020.

<sup>16</sup> PJM Interconnection, LLC., Order on Compliance Filing, Instituting Section 206 Proceeding, and Establishing Paper Hearing, FERC Dockets ER19-469-000 et al., October 17, 2019.

<sup>17</sup> Southwest Power Pool, Order on Compliance Filing and Instituting Section 206 Proceeding, FERC Dockets ER19-460-000 et al., October 17, 2019.

<sup>18</sup> PJM Interconnection, LLC., Motion of PJM Interconnection, L.L.C. to Hold Proceedings In Abeyance and for Shortened Comment Period and Expedited Action, FERC Dockets ER20-584-000 et al., February 27, 2020.

<sup>19</sup> American Public Power Association et al., Petition for Review, v. FERC (D.C. Cir. 2019), July 15, 2019.

<sup>20</sup> A potential outcome of the complaint could be a FERC approved opt-out provision; however, we believe at this point in time most other tariff changes will remain in effect.

For instance, potential investors and developers might ask the following questions:

- Which tariff proposals appear to present more opportunities and flexibility to value stack across markets (capacity, energy, and reserves/regulation)?
- Which proposals appear to have bidding procedures that are best suited to capturing and communicating the value of a potential storage investment as my organization would operate it with the existing fleet?
- What ISO markets offer more opportunities and under what conditions (i.e. shorter minimum run-times for potentially high capacity prices)?
- Where are the natural entry-points for each of these markets for early-movers?
- Can differences in retail and wholesale market interest for storage be successfully resolved?<sup>21</sup>

These, and other questions, can be answered now that Order No. 841 compliance is in advanced stages. CRA's Energy Practice has the quantitative tools (such as our internal "ESOP" model),<sup>22</sup> market planning expertise, and regulatory knowledge to help investors answer these questions.

## About CRA's Energy Practice

Charles River Associates is a leading global consulting firm that offers strategic, economic, and financial expertise to major corporations and other businesses around the world. CRA's Energy Practice provides services to a wide range of industry clients, including utilities, ISOs, RTOs, large customers, and investors. The Energy Practice has offices in Boston, New York City, Washington, DC, Toronto, and London. Learn more at [www.crai.com/energy](http://www.crai.com/energy).

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<sup>21</sup> Federal Energy Regulatory Commission, Order on Compliance Filing, FERC Docket ER19-465-000, November 21, 2019.

<sup>22</sup> CRA Energy consultants developed the Energy Storage resources Operations (ESOP) model to assist asset owners to model optimal storage revenues from energy and ancillary services markets.