




FERC Order 841: Electric Storage Participation in Markets

Manual 11: Energy & Ancillary Service Operations
Manual 18: PJM Capacity Market

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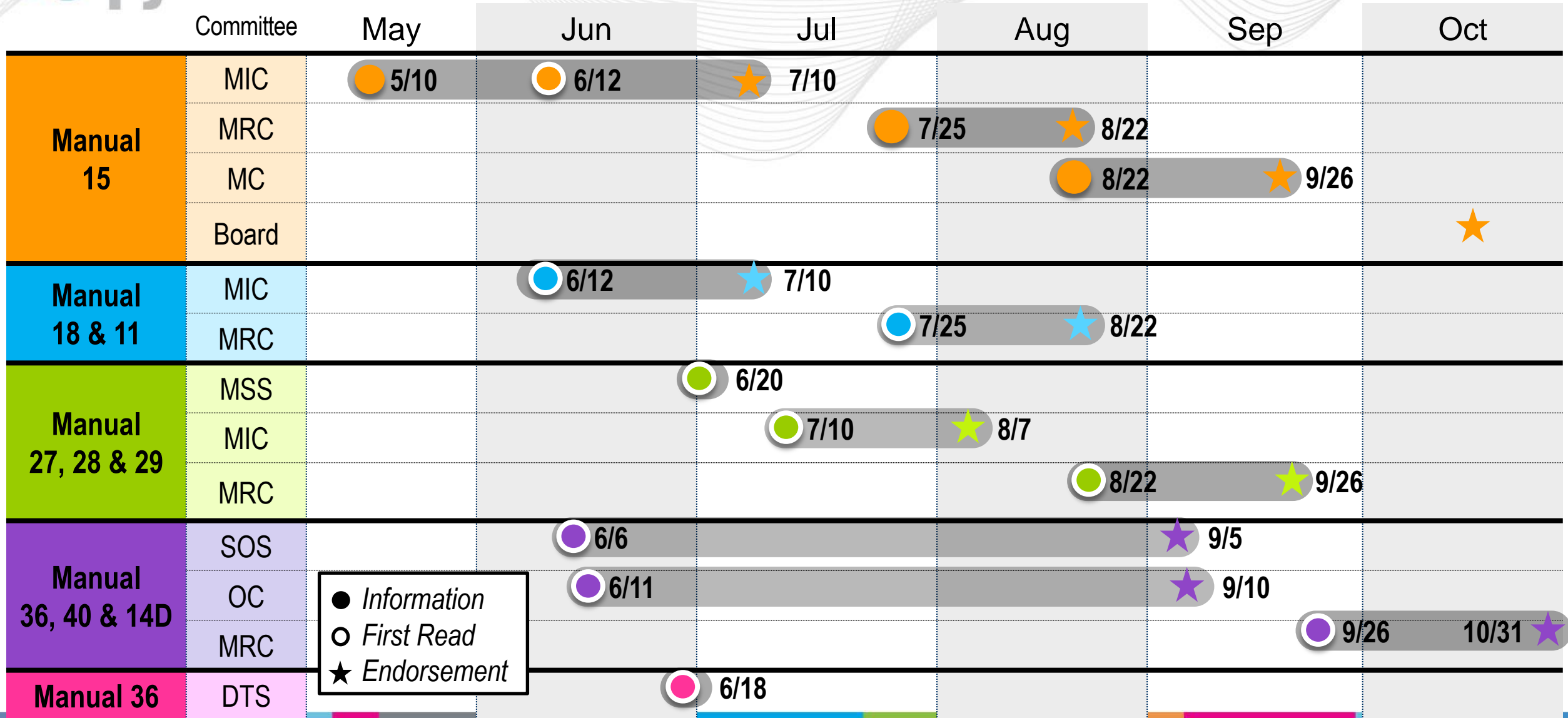
1. Can sell* energy, Capacity, and A/S (incl. Black Start etc.)
the resource is technically capable of providing
2. Dispatched and sets price as seller and buyer
3. Bid parameters that account for ESR characteristics
4. Min market threshold is 100 kW  = already in compliance
5. Stored MWh are billed at LMP as wholesale

* "Eligible to provide..."

- Update for FERC Order 814 Electric Storage Resource Participation Model
 - Added section 2.3.4B Energy Storage Resource (ESR) Participation Model and clarification throughout where appropriate
 - Defined modes: charge, discharge and continuous
 - Opt in and out process for the ESR participation model
 - Updated ESR hourly limits

- Market Sellers can choose to self-schedule their generation into the Day-ahead Market or submit an offer into the Day-ahead Market and allow PJM to schedule their generation.
 - Resources enrolled in the Energy Storage Resource (ESR) participation model may self-schedule only. **When self-scheduling ESR resources, Market Sellers must specify the hourly mode of operation as described in Section 2.3.4B and an operating range as described in Section 2.3.3.2.**
- **Self-scheduled generation shall submit an hourly operating range and can offer an associated price/MW pairs for consideration in dispatch**

- Manual 18: PJM capacity Market
 - Updated definition of Capacity Storage Resource
 - » Capacity Storage Resources shall mean Energy Storage Resource that participates in the Reliability Pricing Model or is otherwise treated as capacity in PJM's markets such as through a Fixed Resource Requirement Capacity Plan
 - Clarified that ESRs may not receive Peak Load Contributions for energy they charge and then later sell back to the grid



- Questions: esr@pjm.com
- [Issue Tracking: Electric Storage Participation - FERC Order 841](#)

Appendix: Additional Information



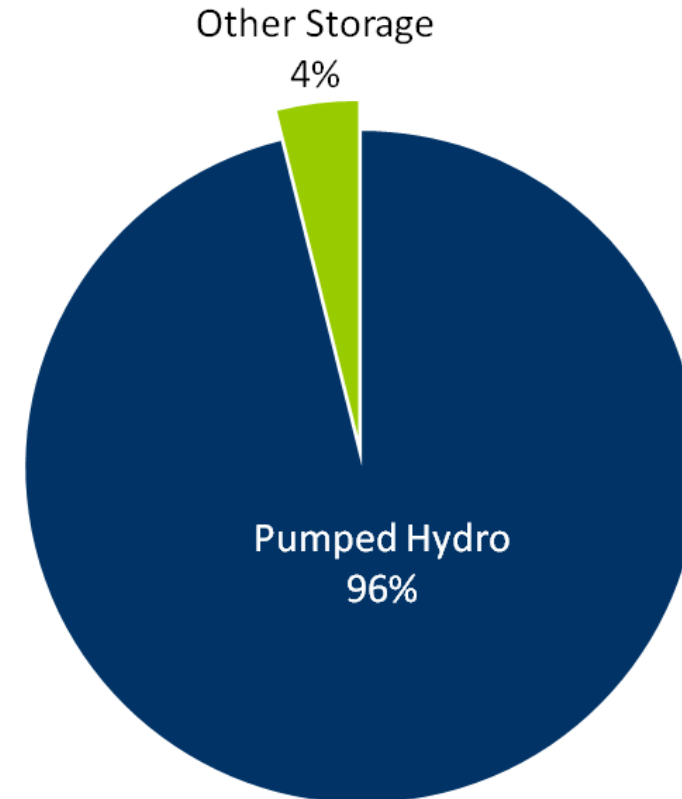
Timeline of FERC Order 841

	2016	2018				2019			
	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
FERC NOPR on Energy Storage & Distributed Energy Resources	Nov. 4, 2016								
FERC Final rule Electric Storage Participation Markets		Feb. 15, 2018							
PJM ESR Accounting Proposal Filing					Dec. 3, 2018				
PJM ESR Markets & Operations Proposal					Dec. 3, 2018				
PJM limited answer to ESR Filing					Dec. 10, 2018				
PJM Responds to Protests & Comments						Mar. 5, 2019			
FERC Request for Additional Information						Apr. 1, 2019			
PJM Response to FERC Questions						May 1, 2019			
PJM Submits Additional Answers						May 14, 2019			
FERC Order on Rehearing and Clarification						May 16, 2019			
Implementation									Dec. 3, 2019

Electric Storage Resource Definition

- Electric Storage Resource (**ESR**)= “a resource capable of receiving electric energy from the grid and storing it for later injection of electric energy back to the grid.”
- Connected at: transmission, distribution, or behind a customer meter.
 - PJM has ESR at both T and D today, none behind a meter **that inject.**
- Excludes demand response.
- Includes pumped hydro

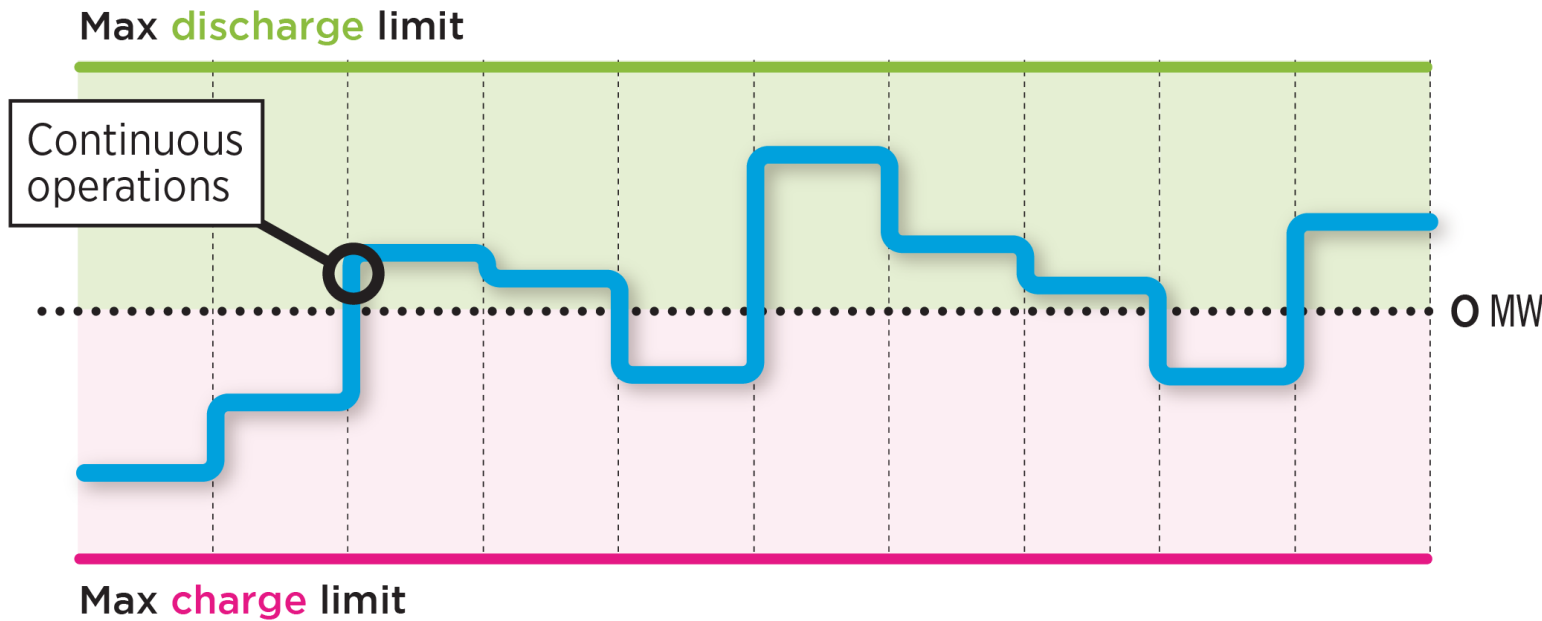
Over 5,300 MW of Electric Storage Resources currently in PJM



** Data taken from Generation Queue and EIA 860

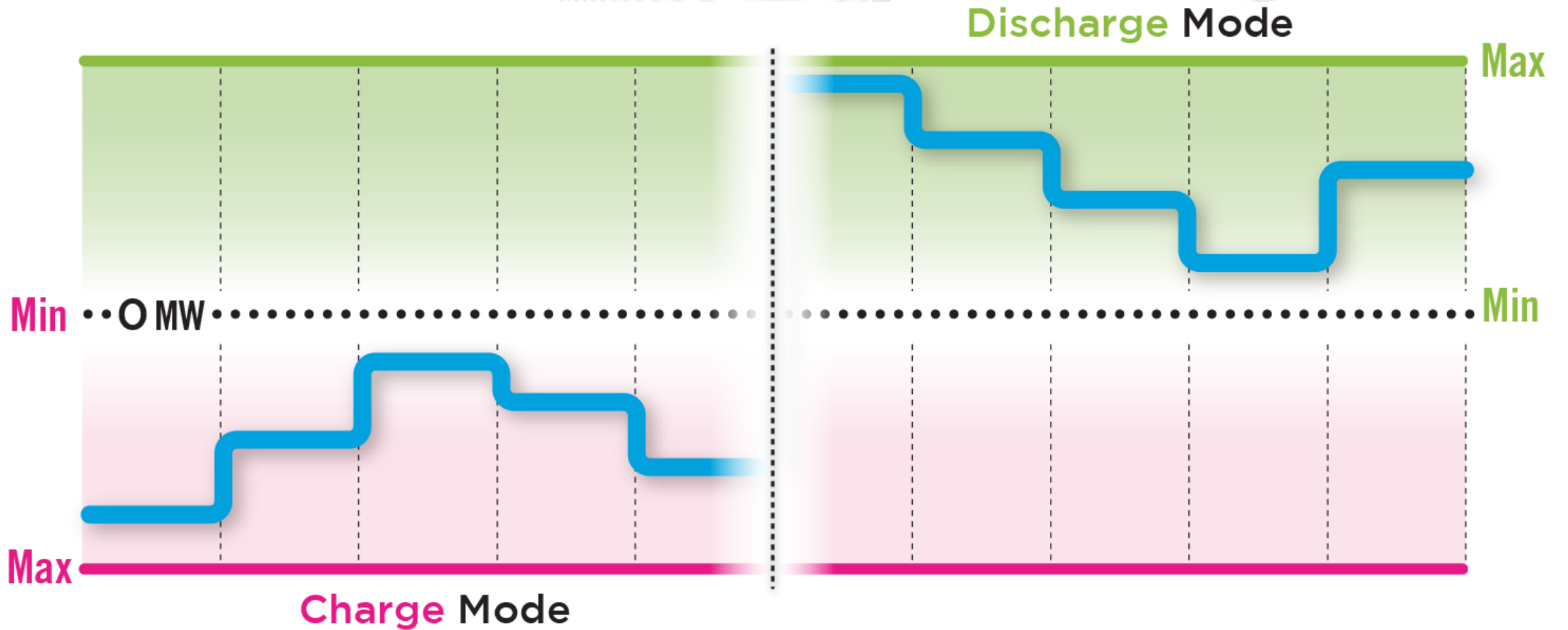
- ESRs will be modeled as one continuous resource
- PJM will not make commitment decisions in the ESR model
 - Start-up and no load cost will not be considered
- PJM will not manage state of charge
 - Resource owners use mode of operation, offers, and parameters
- 3 modes of operation:
 - Continuous, Charge & Discharge
- Parameters
 - Max/Min charge/discharge, etc
 - Ramp rate considered infinite only in continuous mode

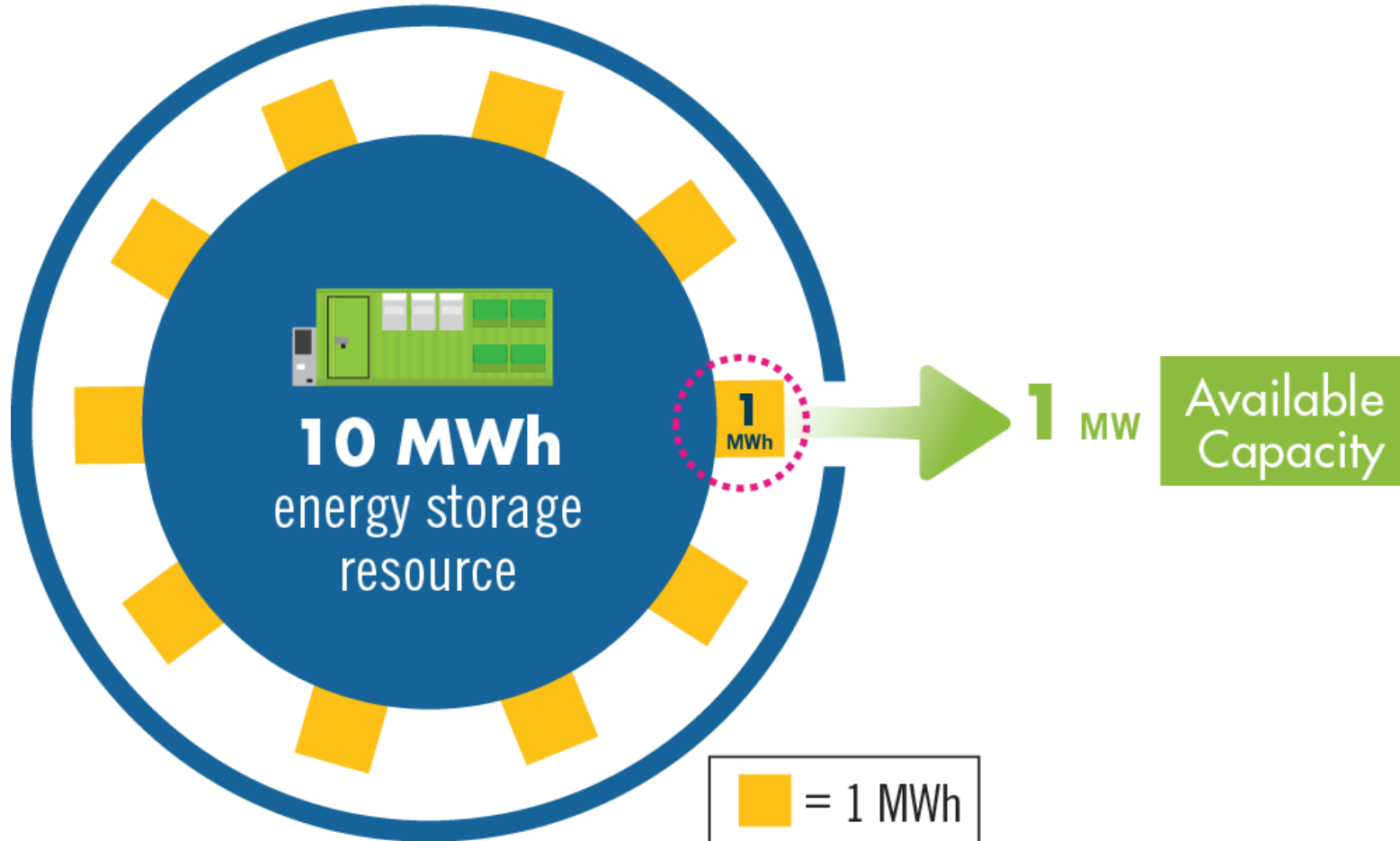
ESRs can update their max charge and discharge limits hourly in day-ahead, and more frequently in real-time.



Price	MW
\$ 10.00	20
\$ 9.00	15
\$ 8.00	10
\$ 7.00	5
\$ 6.00	0
\$ 5.00	0
\$ 4.00	0
\$ 3.00	-5
\$ 2.00	-10
\$ 1.00	-15

** State of charge telemetry will be requested for telemetered resources





PJM maintaining the requirement, per manual 21, that capacity resources have a minimum 10 hour duration.

ESR capacity interconnection rights will be derated based on the total energy capability of the resource
- Total MWh/10h

- November 4, 2016 [FERC NOPR on Energy Storage and Distributed Energy Resources.](#)
- February 15, 2018 [FERC Final rule Electric Storage Participation Markets](#)
- December 3, 2018
 - [PJM ESR Accounting Proposal filing](#)
 - [PJM ESR Markets and Operations Proposal](#)
- December 10, 2018 [PJM limited answer to ESR filing](#)
- March 5, 2019 [PJM responds to protests and comments](#)
- April 1, 2019 [FERC Request for Additional Information](#)
- May 1, 2019 [PJM Response to FERC Questions](#)
- May 16, 2019 [FERC Order on Rehearing and Clarification](#)
- May 14, 2019 [PJM submits additional answers](#)
- **Dec 3, 2019 [Implementation Issue Tracking](#)**