



Electric Storage Resources Participation Model: PJM Compliance Filing for Order 841



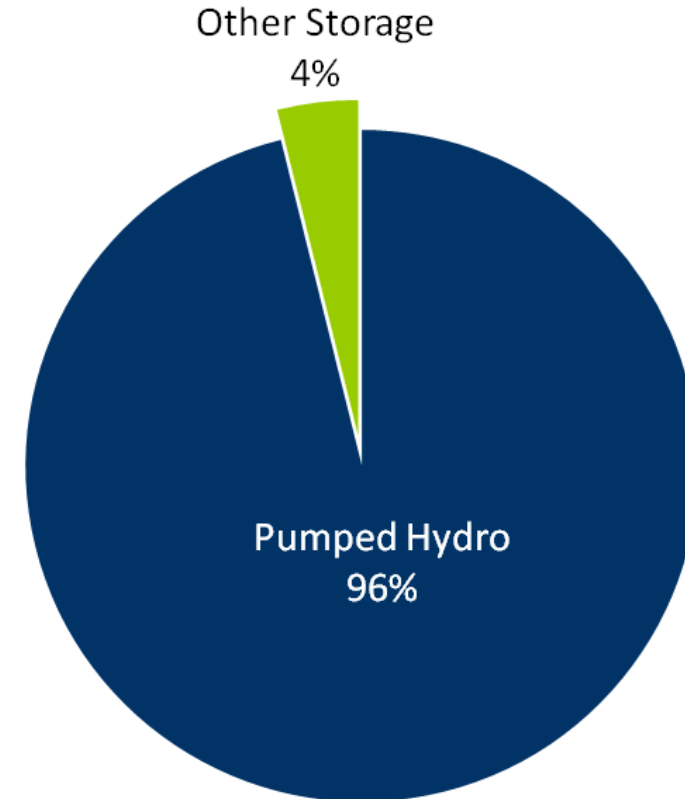
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- February, 2018: [FERC Order 841](#) – Electric Storage Participation in Organized Wholesale Electric Markets
- **Filing submitted Dec 3, 2018.**
 - PJM Filings:
 1. Markets and Operations Proposal, ER19-469-000
 2. ESR Accounting Proposal, ER19-462-000
- **Comments due December 21, but extension requested by multiple parties until February 7, 2019**
- **Implementation deadline Dec 3, 2019.**


Electric Storage Resource Definition

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

- Energy Storage Resource (**ESR**)= “a resource capable of receiving electric energy from the grid and storing it for later injection to the grid that participates in the PJM Energy, Capacity, and/or Ancillary Services markets as a Market Participant.”
- Can be connected to transmission, distribution, or behind the meter.



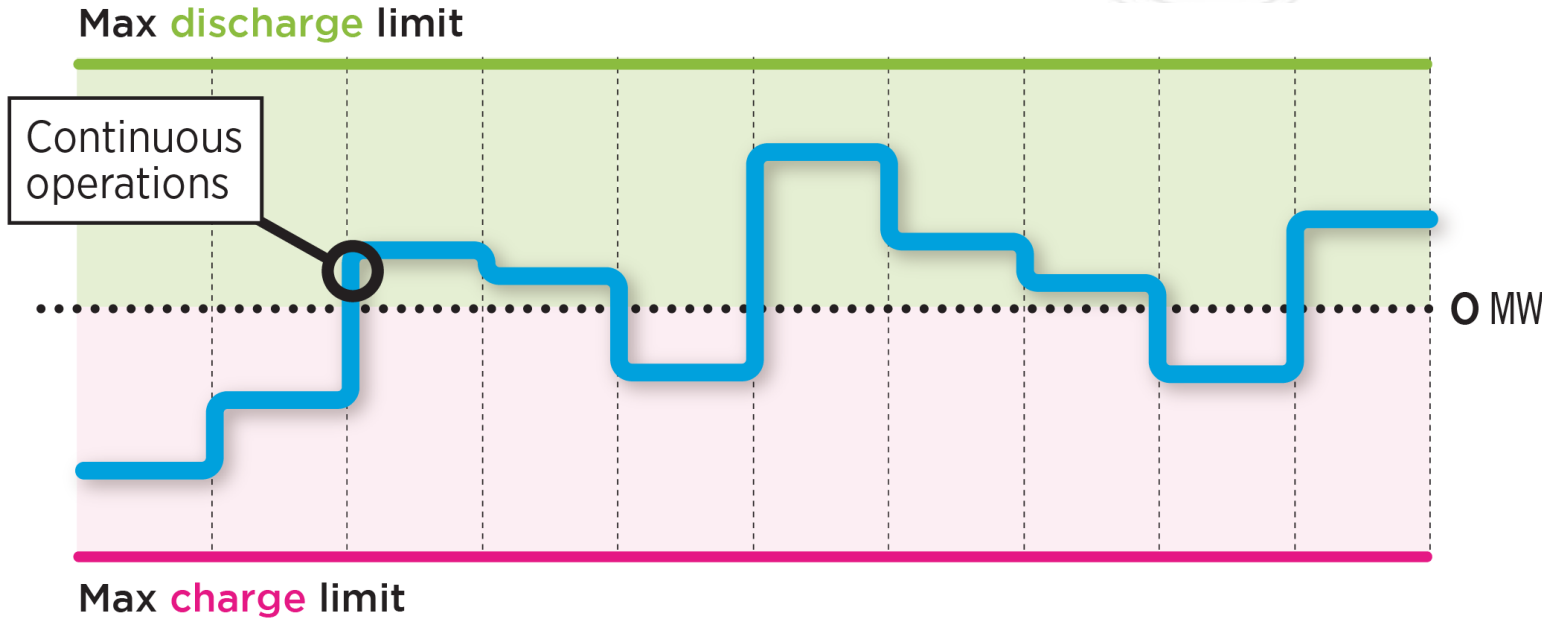
** Data taken from Generation Queue and EIA 860

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 
5. Stored MWh are billed at LMP as wholesale

* "Eligible to provide..."

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

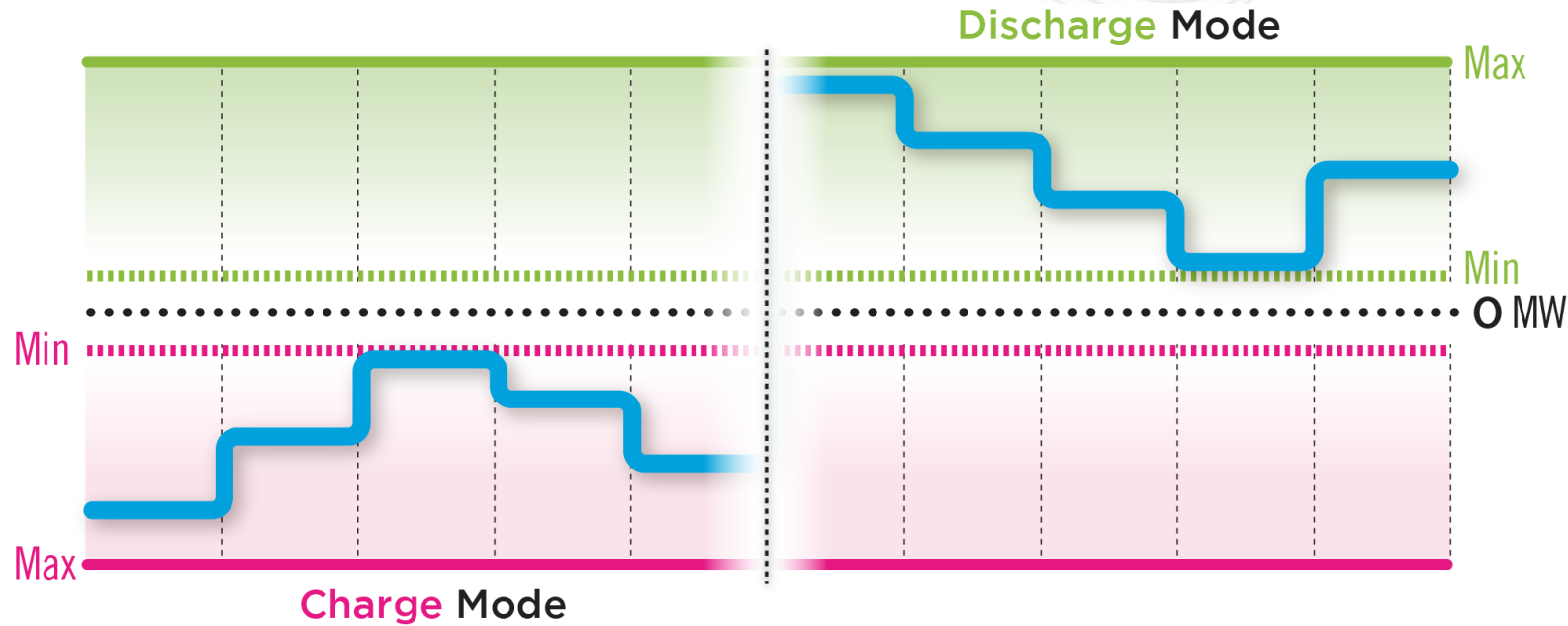
Price	MW
\$ 10.00	20
\$ 9.00	15
\$ 8.00	10
\$ 7.00	5
\$ 6.00	0
\$ 5.00	0
\$ 4.00	0
\$ 3.00	-5
\$ 2.00	-10
\$ 1.00	-15



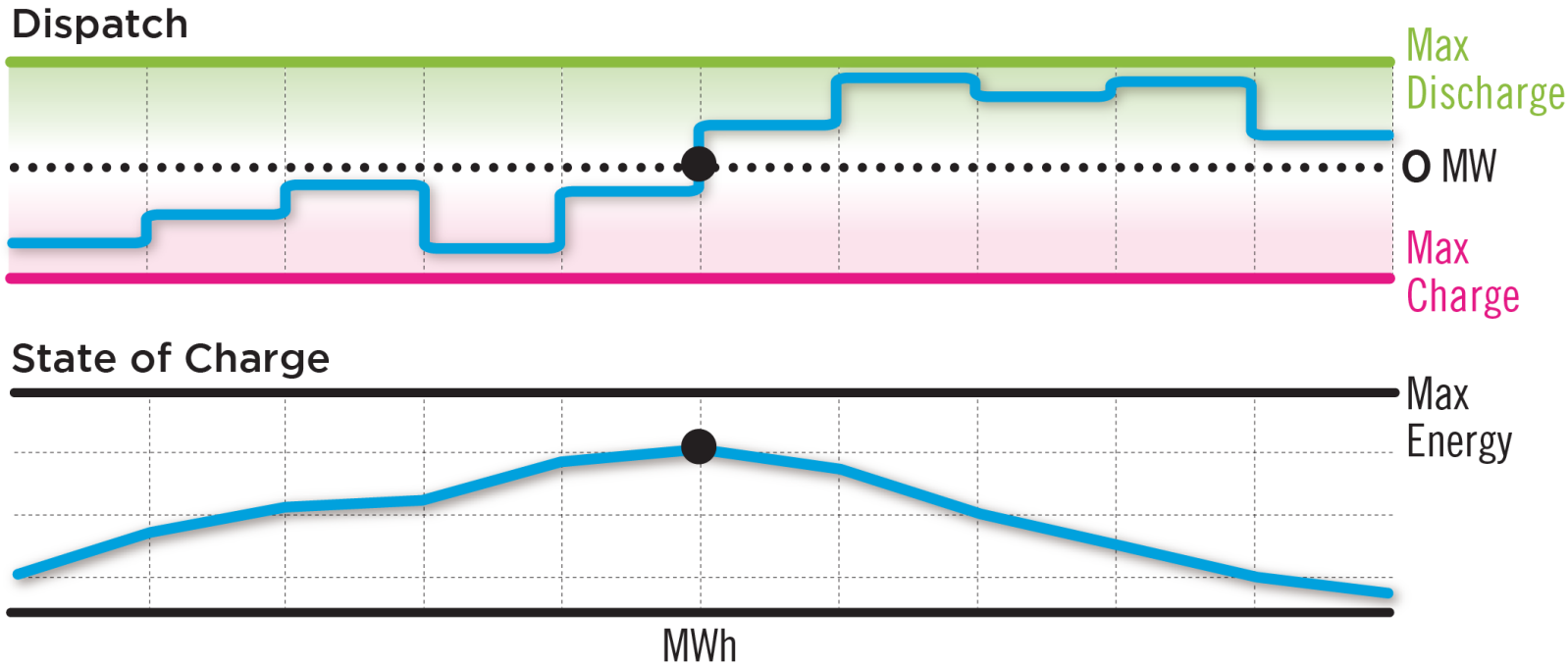
Continuous operation mode - ESRs can update their max charge and discharge limits hourly in day-ahead and more frequently in real-time.

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

Charge and Discharge Mode



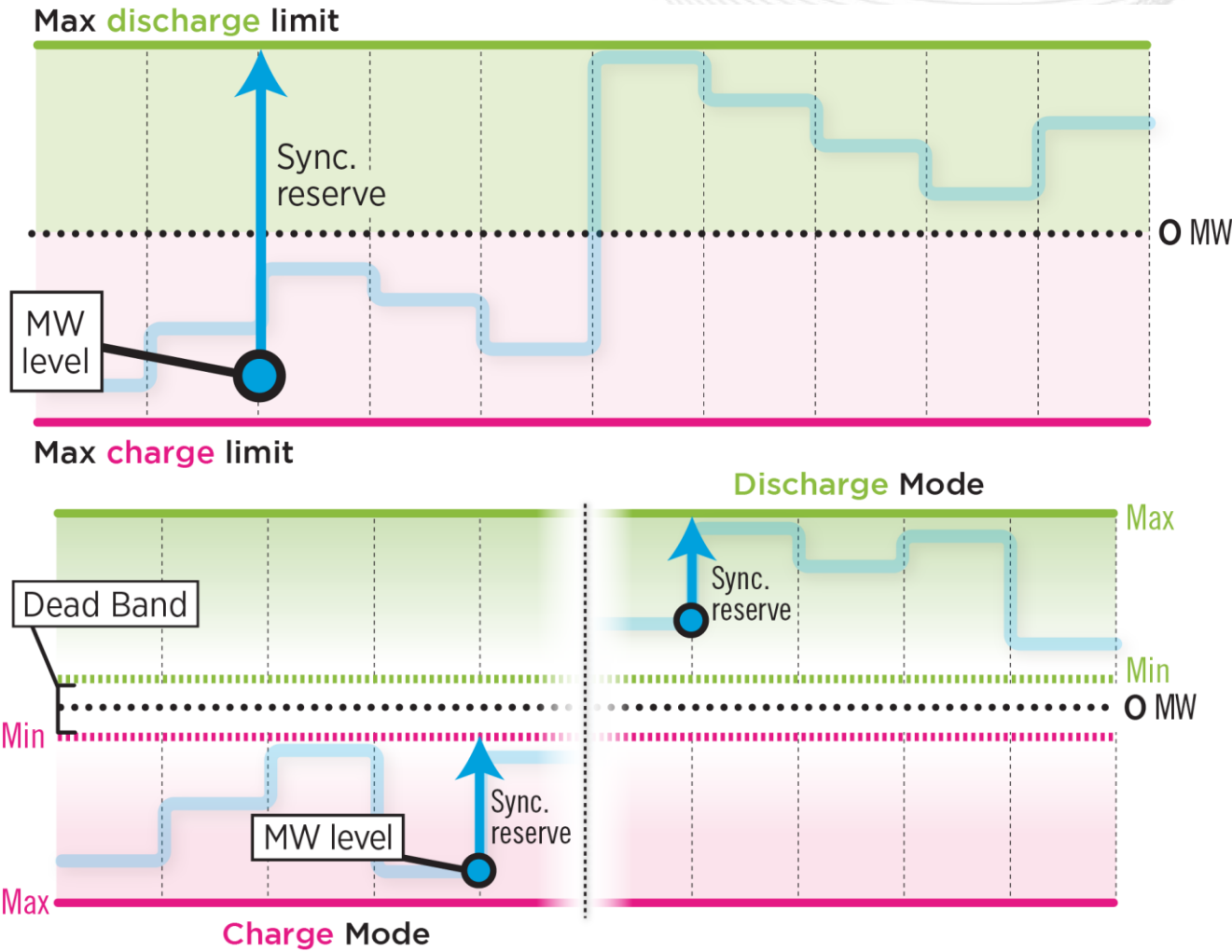
Charge & Discharge mode will be available to ESR resources in DA and RT



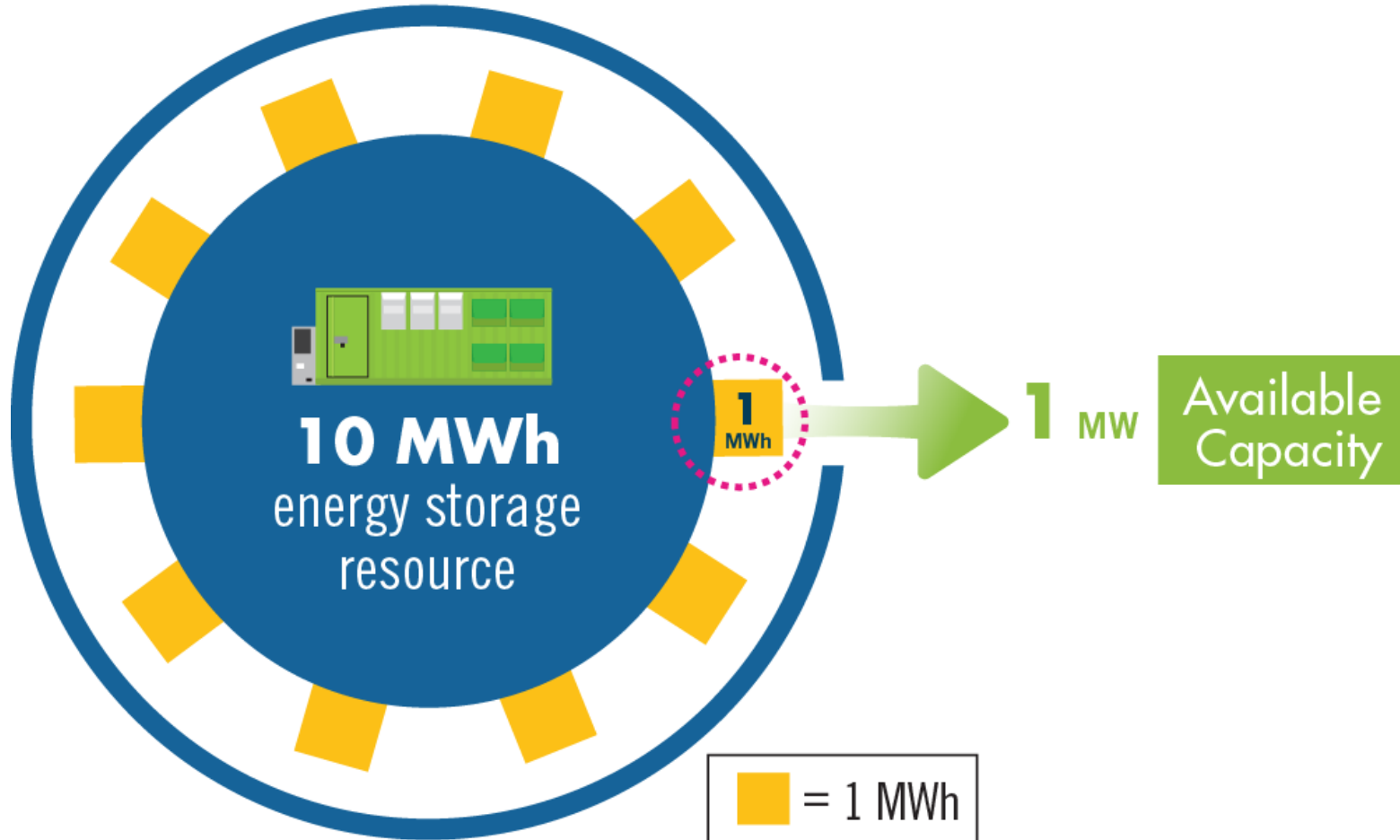
ESR resources can manage their own state of charge through the different modes and updates to limits, as well as hourly price offers in DA. Self-schedule will be available for ESRs.

- Synchronized Reserve Amounts will need to be offered in and updated in RT.
- ESRs will opt-in for synchronized reserves
- Possible to offer synchronized reserve without energy offer (Similar to regulation)

Calculation of Synchronized Reserves (cont.)



In all modes, the full amount of response provided during an event will determine compensation.



PJM proposes that status quo, per manual 21, of a minimum of 10 hour duration is maintained in the capacity market.

- Developing a methodology to determine wholesale vs. non-wholesale charges for stored energy
 - “Direct Charging Energy”
 - “Load Serving Charging Energy”
- PJM requested an earlier order date on the ESR Accounting Proposal, allowing more time to work out implementation details

Questions or Feedback?

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