Energy Storage Resources: Opportunities in PJM Wholesale Markets

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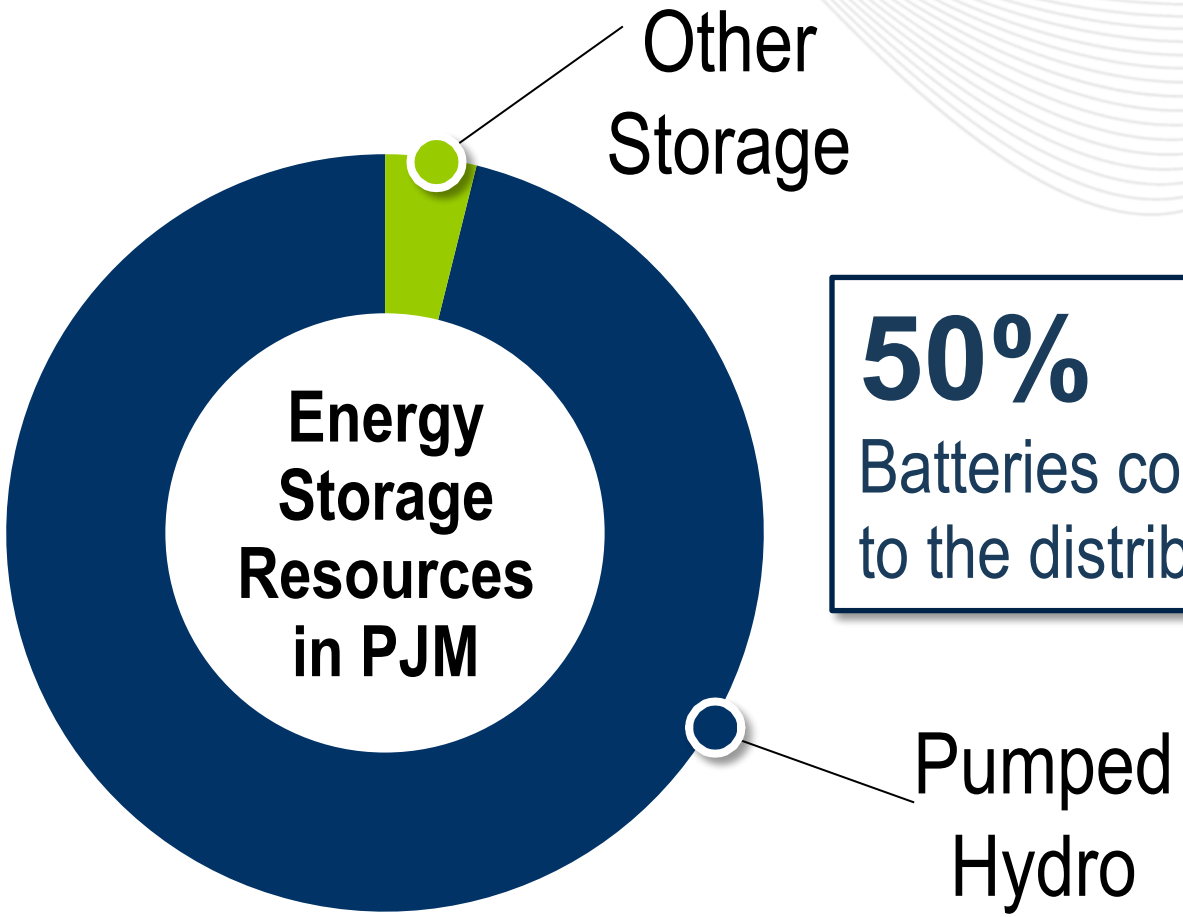
Over 5,300 MW of ESR currently in PJM

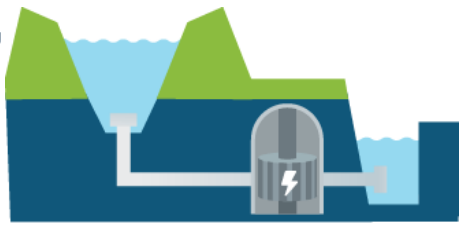


Other storage is about ~300 MW of mostly batteries

50% Batteries connected to the distribution system

50% Connected to the Bulk Electric System

Pumped hydro currently participates in capacity, energy, regulation and reserves



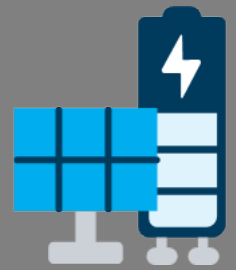
Data taken from Generation Queue and EIA 860

Energy Storage in PJM Today

Energy Storage Model

Effective Load Carrying Capability

Battery Hybrid Resources

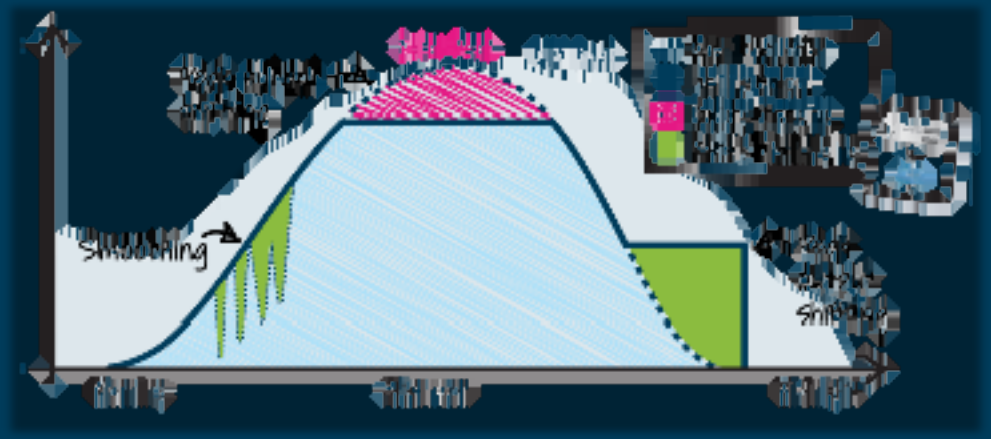


Regulation

Storage and Hybrids in the PJM Interconnection Queue

~260 GW Total (nameplate)

Over 90% solar, wind, battery, hybrid



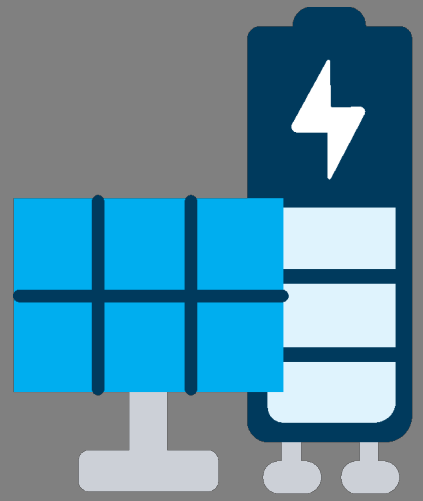
~40 GW
Hybrid resources

~54 GW
Stand-alone storage

Evolving PJM Market Policy

Resource Adequacy (RASTF)

Regulation Re-design (RMDSTF)

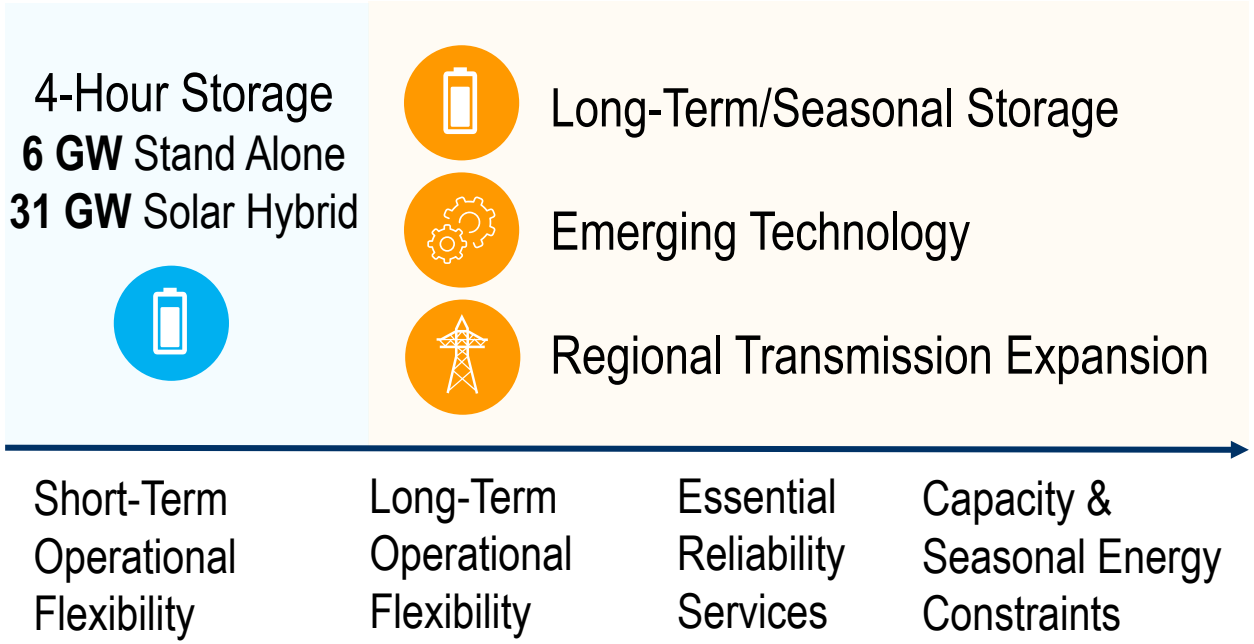


DER Aggregation Model (Order 2222 – DISRS)

Energy Transition & Grid of the Future

Focus Area No. 5

Energy Storage (4-hours) Enhances Operational Flexibility, but Seasonal Capacity and Energy Constraints Require Transmission Expansion, Long-Term Storage, and other Emerging Technology.



KEY INDICATORS

- Storage provides up to 80% synch-reserves and 30% of ramping requirements
- Congestion increased by 60%
- Renewable curtailment 16%