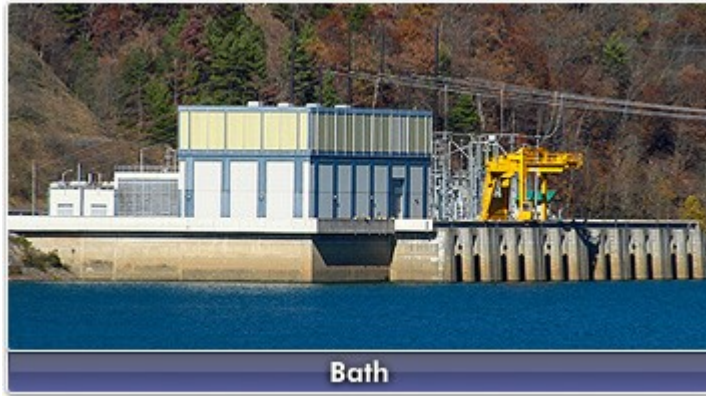


Energy Storage Integration

Hong Chen
PJM Interconnection
June 26, 2017





Pumped Storage Hydro



Batteries



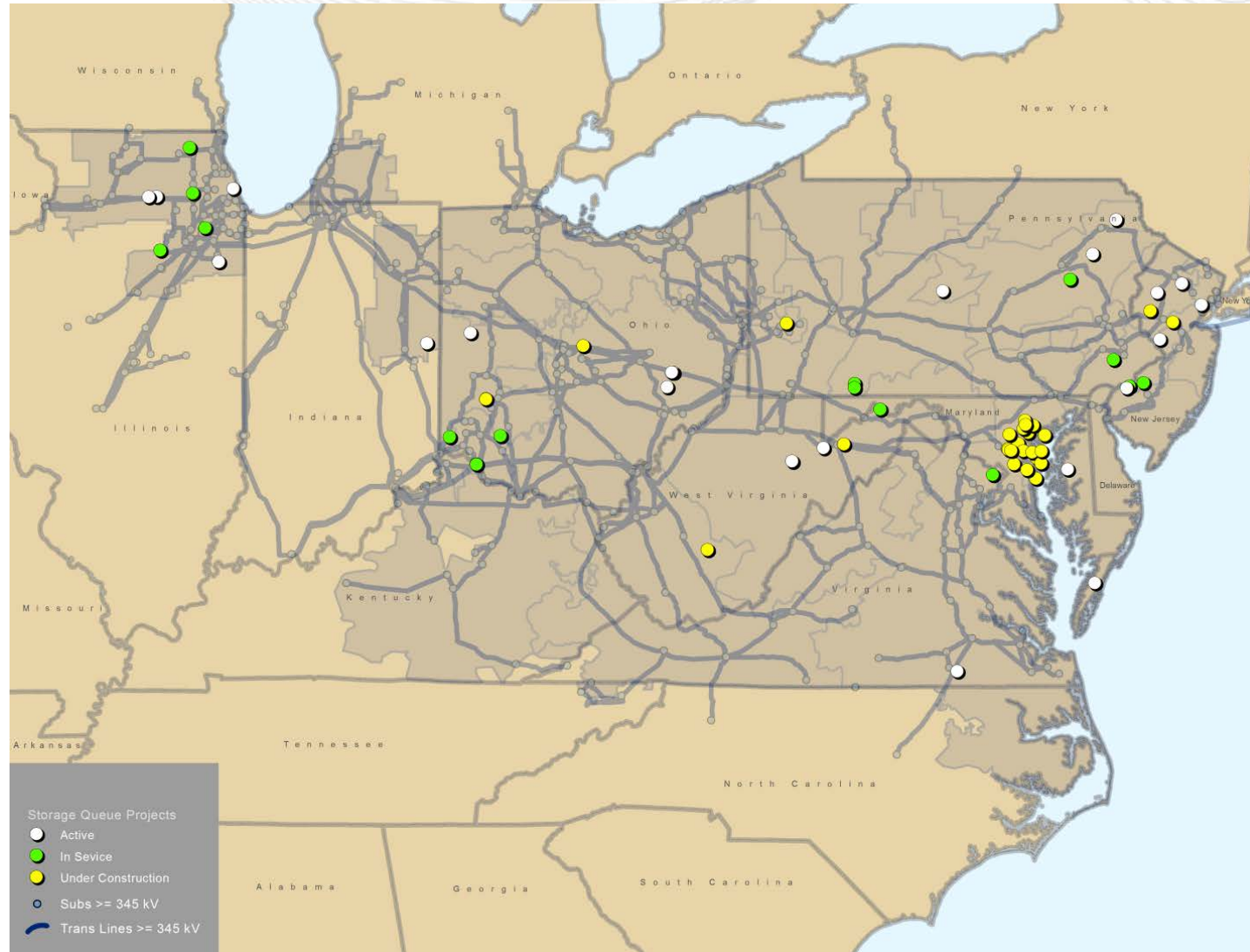
Flywheels



Electric Vehicles



Thermal Storage

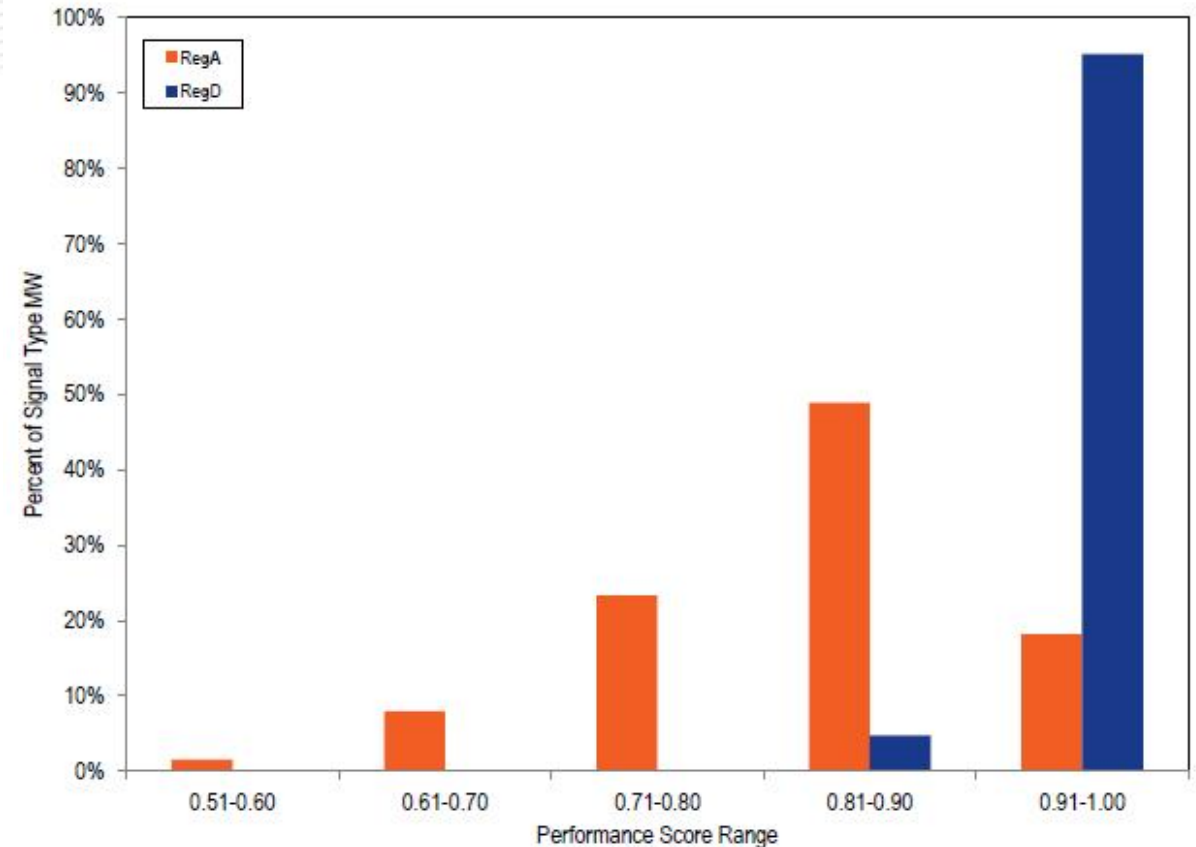


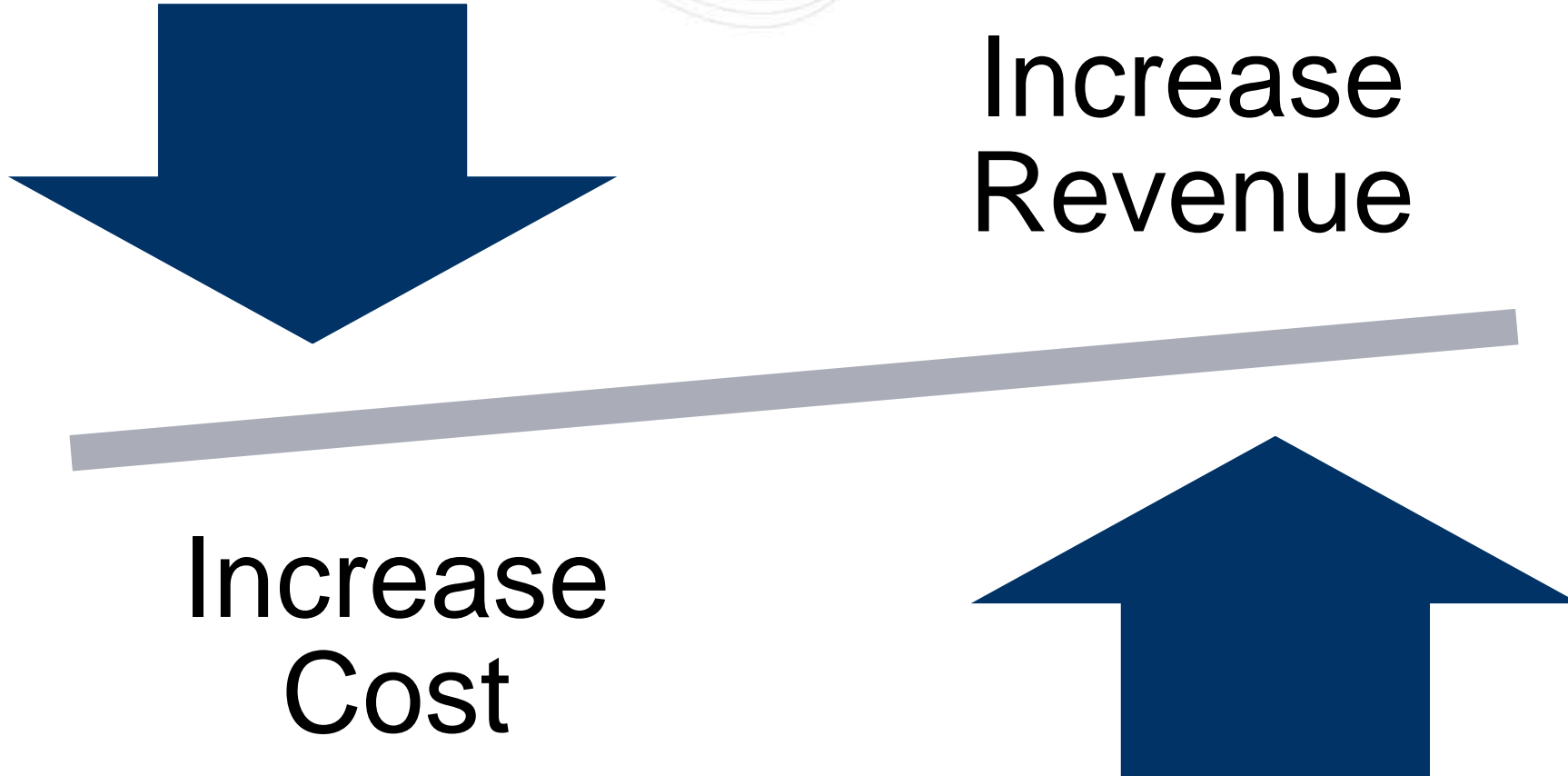
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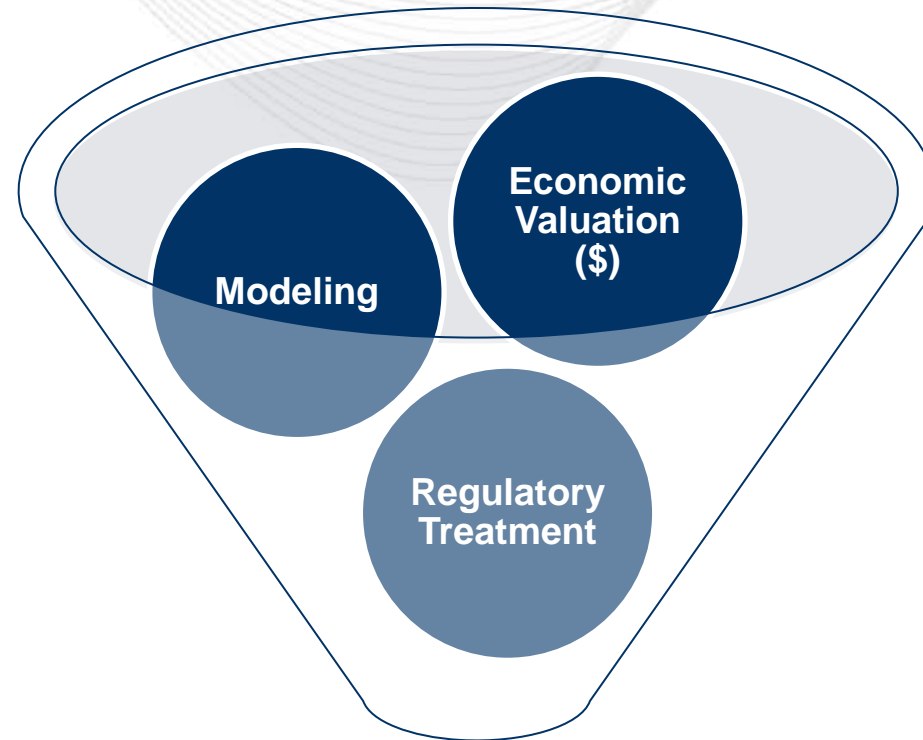
Electric Storage Resource by Technology	Installed Capacity / Qualified Rating (MW)	Capacity	Energy	Ancillary Services
Pumped Storage Hydro (Generation)	5,537	Yes	Yes	Yes
Battery (Generation)	289	No	No	Yes
Flywheel (Generation)	20	No	No	Yes
Battery (Demand-side Resource)	14	Yes	No	Yes

- Resource owner submits additional parameters
 - Starting pond level (MWh)
 - Ending pond level (MWh)
 - Minimum pond level (MWh)
 - Maximum pond level (MWh)
 - Pumping efficiency factor
- PJM optimizes the schedule to meet these parameters and constraints.
 - Hourly plant pond level constraints
 - Either pump or generate for the hour: designated by owner
 - Daily storage level constraint that incorporates the efficiency factor

- Performance-based regulation market: RegA, RegD
- Control ACE
- Conditionally energy neutrality







Success!