

Load Participation in Ancillary Services

System Operator Perspective

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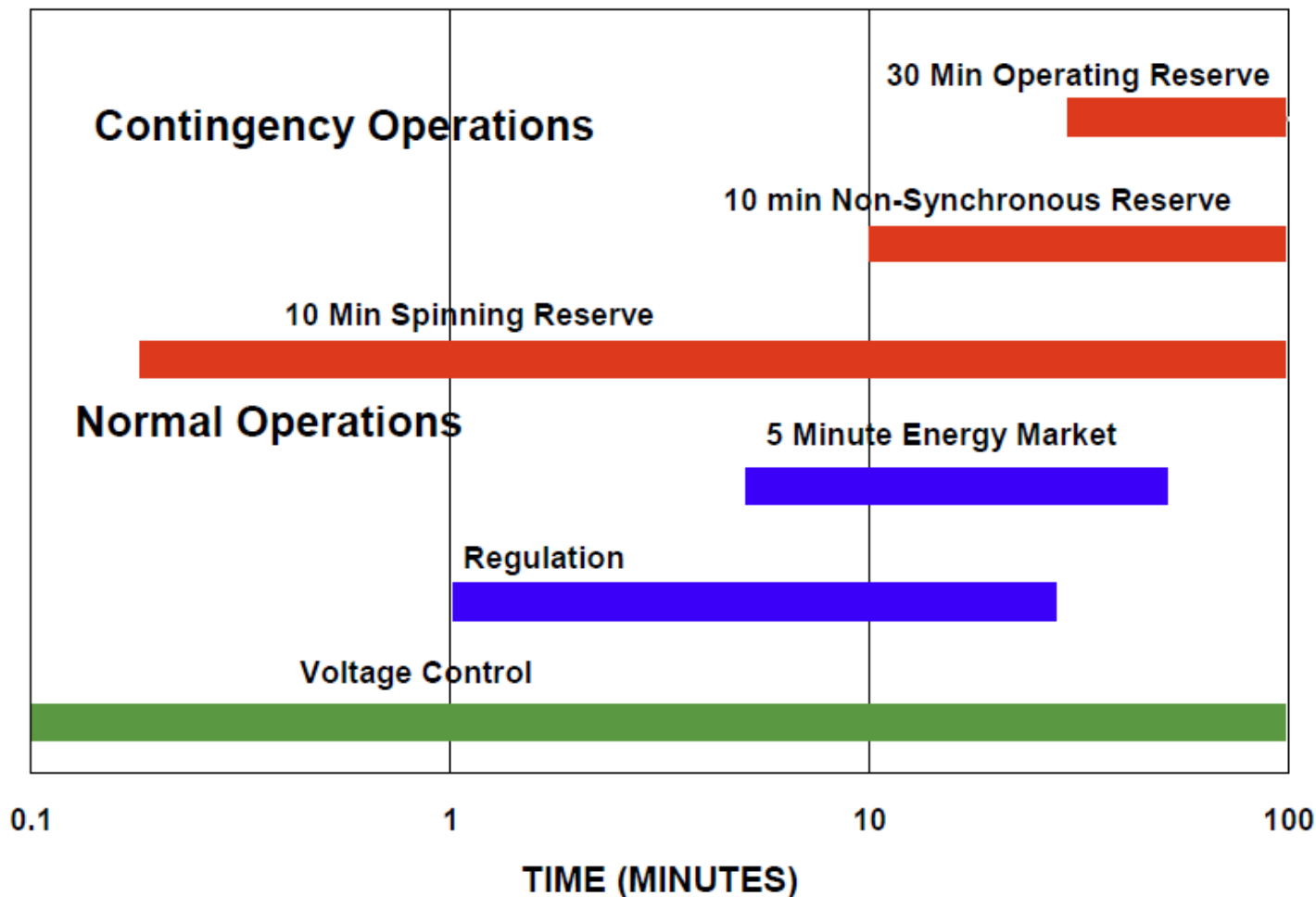
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Ancillary services

- Ancillary services as defined by FERC (Order 888):
 - (1) Scheduling, system control, and dispatch.
 - (2) Reactive supply and voltage control.
 - (3) Regulation and frequency response.
 - (4) Energy imbalance.
 - (5) Operating reserves - spinning reserves.
 - (6) Operating reserves - supplemental reserves.
- Current markets for ancillary services in ISO/RTO systems:
 - Regulation.
 - Spinning reserves.
 - Non-spinning reserves.
- Potential markets:
 - Wind ramping events do not qualify as contingency events; no 10-minute requirement is needed. High wind penetration may need a new ancillary service for ramping that varies with season and time of day.
 - Frequency Responsive Reserve for 30-second (or faster) response for contingencies.



Ancillary services are distinguished by response time, duration, and frequency



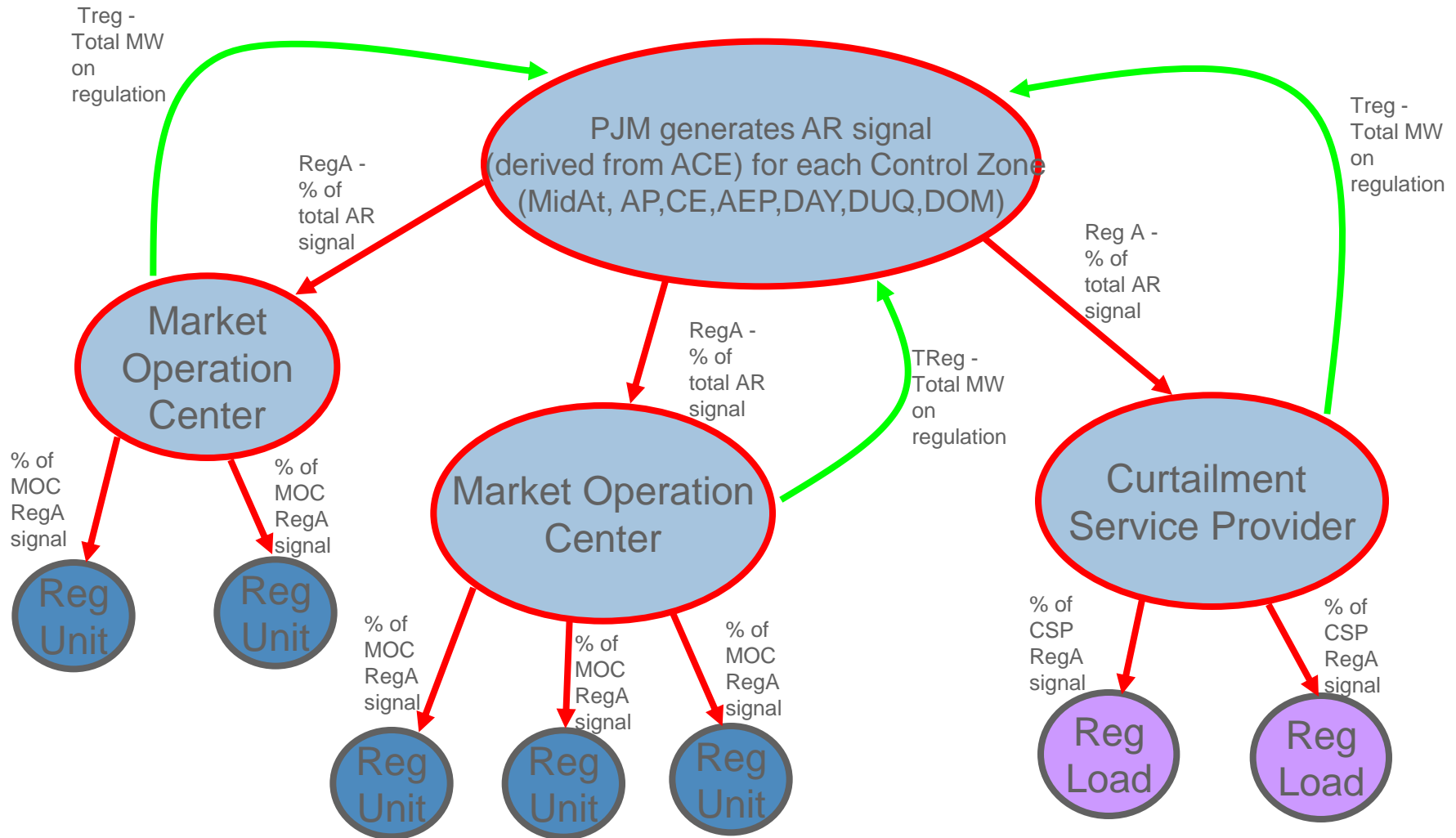
Response time and duration characterize required NYISO ancillary service response.

PJM demand response in ancillary service markets

- **Day ahead scheduling reserves (30 minute spin).**
 - Must reduce net load within 30 minutes if dispatched by PJM.
 - Hourly market price (DAMCP).
- **Synchronized Reserves (10 minutes spin).**
 - Reduce load during reserve shortage, must reduce net load within 10 minutes.
 - Hourly market price (SRMCP).
- **Regulation – real time load change (increase or decrease) based on real time system conditions.**
 - Hourly market price (RMCP).



Regulation in real-time operations



* Note: CSP must reverse sign of AR signal for Demand Resources

Ancillary service load participation in ISO/RTO markets, 2007

- AESO – 380 MW (3.9% of summer peak demand)
- IESO – 906 MW (3.6%)
- ERCOT – 1,963MW (3.1%)
- MISO – 400 MW (0.3%)
- CAISO – 90 MW (0.2%)
- PJM – 116 MW (0.0%) → 250 MW in 2011 (0.0%)



PJM demand response stats

PJM demand-side response participation (2011):

- Economic program: 2,186 MW
- Capacity program: 11,826 MW
- Synchronized reserves: 250 MW
- Regulation: 0 MW
- Day-ahead scheduling reserves: 0 MW



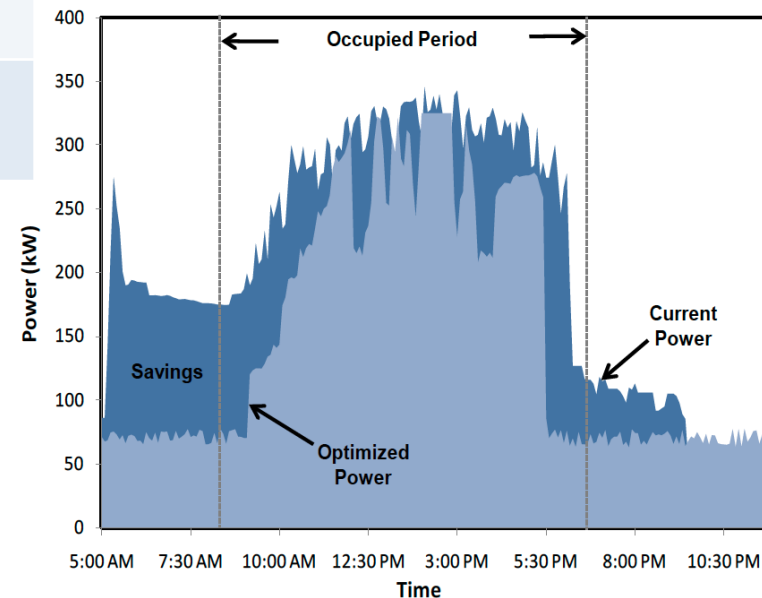
Example: Ancillary services in commercial building systems

Resource	Ancillary Markets	Time/Capacity
Air-Handling Unit(s) (1-20 per building)	Spinning Demand Response	<10 min/1-10 MW
Dimmable Lighting Systems and Water Heaters	Spinning Regulation Demand Response	<10 min/1-10 MW
Ice and Battery Storage (PHEVs)	Regulation	<10 min/100kW
Backup Generation (e.g., diesel)	Spinning	<30 min/1-10 MW
Co-Generation (e.g., fuel cells)	Spinning Regulation	<30 min/1-10 MW



Argonne's Testing Facility

- 20-30% HVAC energy savings demonstrated



Issues: Comfort, equipment wear (e.g., VAVs).

Proactive Energy Management (EM) Systems

Forecast load and shedding capacity.

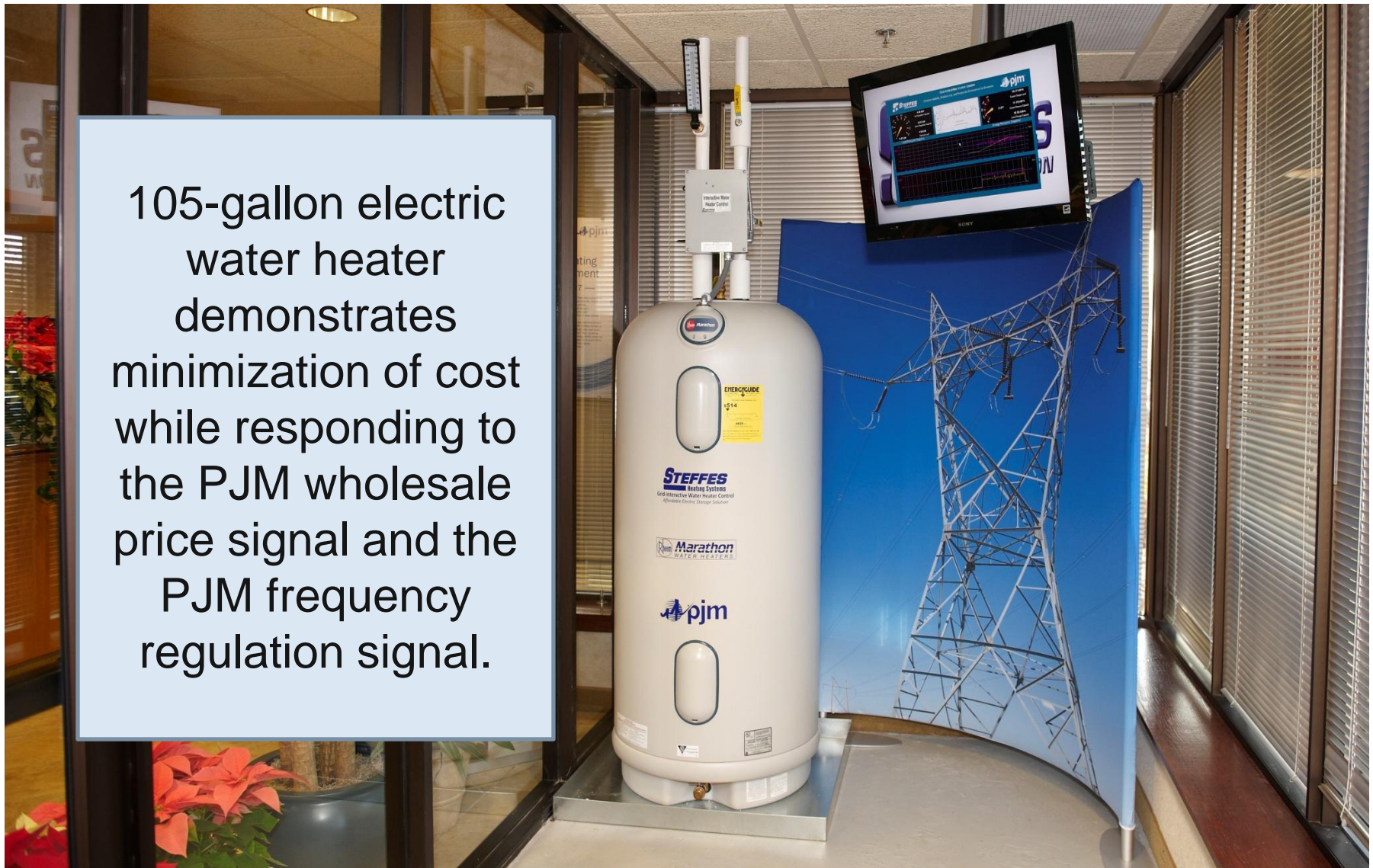
Anticipate ISO signals (demand response, prices).

Minimize impact of load shedding on comfort.

Coordinated management of resources in multiple buildings.

PJM water heater

105-gallon electric water heater demonstrates minimization of cost while responding to the PJM wholesale price signal and the PJM frequency regulation signal.



Water heater – Optimization of LMP and frequency regulation



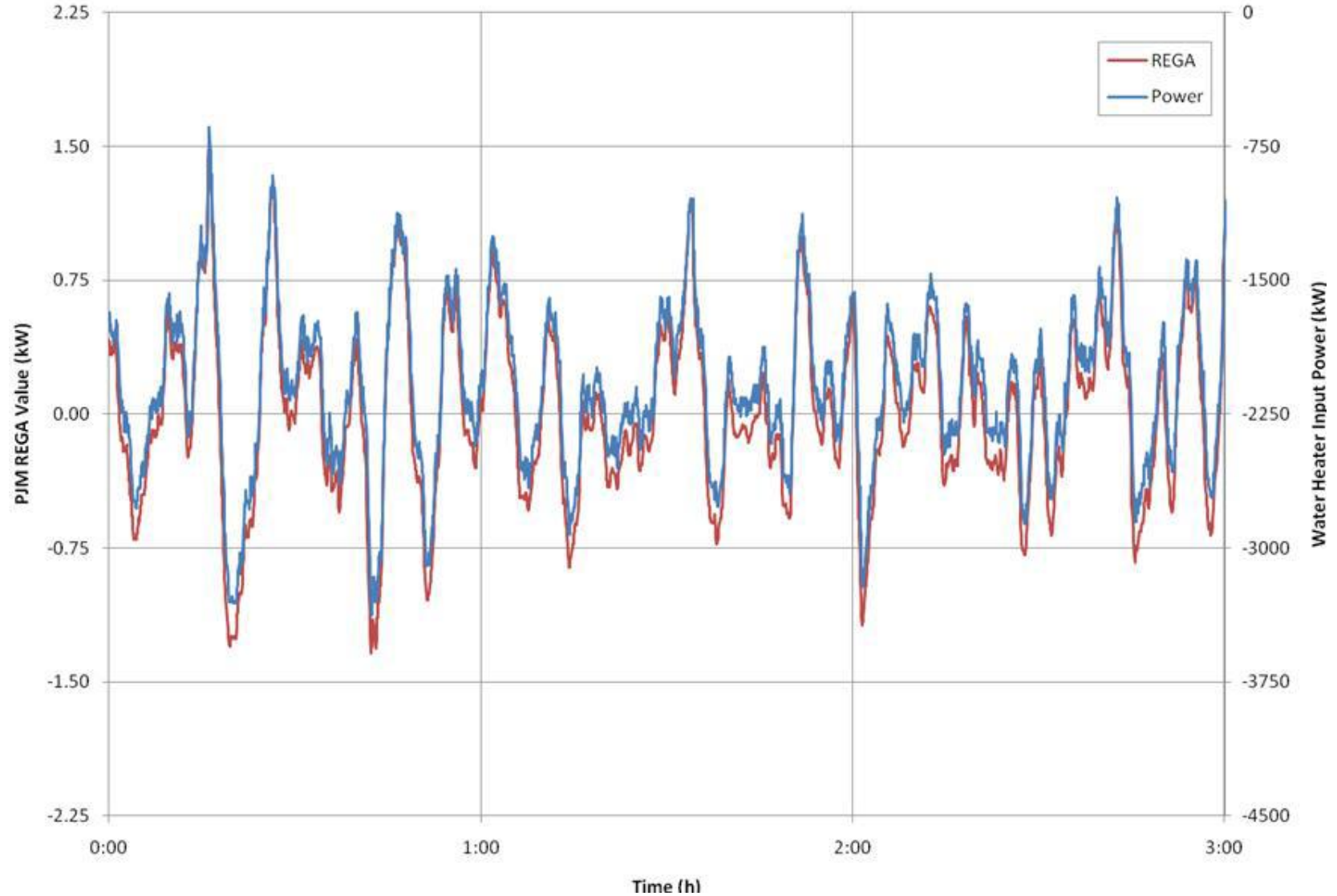
Charging during low LMP periods



Follow PJM frequency regulation



PJM frequency regulation signal and water heater consumption



Barriers identified by FERC for demand response

- Parameter requirements based on generation characteristics, not demand resources.
- Reliability standards that restrict load participation.
- Restrictive telemetry requirements for load participation.
- Mitigation and scrutiny from market monitors for load participants exercising market power.



ASSESSMENT OF Demand Response & Advanced Metering



FERC Order 745 compliance

FERC Final Rule on Demand Response Compensation (Docket RM10-17-000)

On March 15, 2011, FERC issued its final rule regarding demand response economic compensation.

- FERC final rule stipulates that demand response be compensated full locational marginal pricing when two conditions are met:
 - DR has the capability to balance supply and demand; and
 - Payment of LMP to DR is cost effective.

Implementation timeline is dependant upon FERC's acceptance of PJM compliance filing.

- **PJM expects significant increase in Economic Demand Response participation when full LMP is paid.**
- **Increased economic participation may lead to increased ancillary services participation.**



Example targets for DOE programs

- Grid-level market benefit assessment.
 - E.g., potential for mitigation of issues with renewable generation growth.
- Life-cycle analysis of load participation for energy usage, critical emissions, and greenhouse gas production.
- System-level approaches to buildings as multiple-service providers.
 - Optimization of building assets for bidding strategies.
 - Multi-building energy management development.

