ISO New England – Results of Ancillary Service Pilot Programs:

- Alternative Technology Regulation Pilot Program
- Demand Response Reserves Pilot Program

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Alternative Technology Regulation Pilot Program

Alternative Technology Regulation Pilot Program

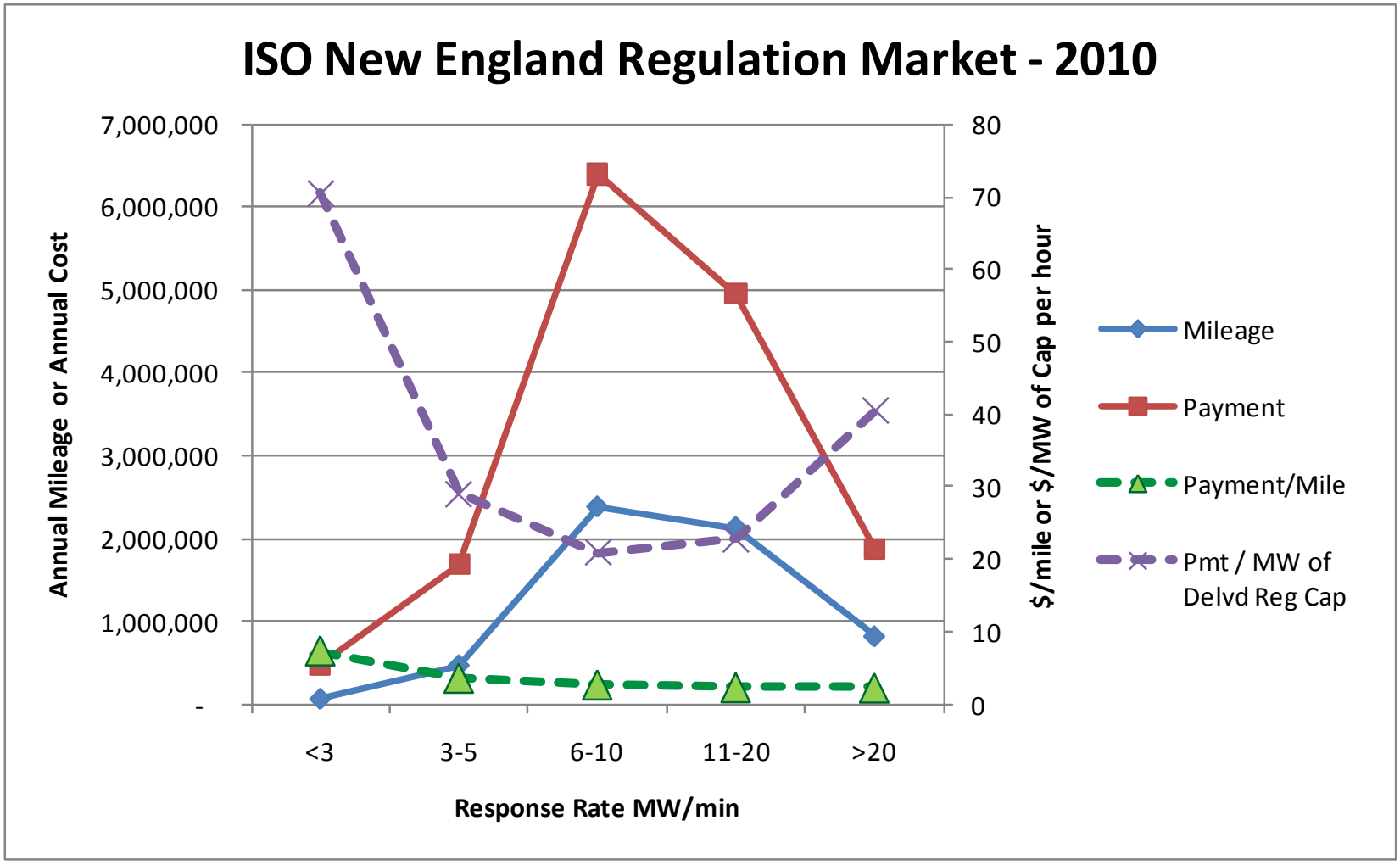
- Why?
  - Stakeholder request
  - Low risk opportunity to evaluate new technologies
  - Allow new technologies to experience realistic operation
  - Minimal impact on the existing regulation market

- What?
  - Limited to 13 MW total to ensure no threat to reliability
  - Incremental to existing regulation market
  - Participants operate as “price-takers”
  - Will continue until permanent market changes are approved and implemented
- When?
  - Commenced 11/2008; closed to new entrants after 11/2009
    - Expected to re-open Q2 2012
  - Will continue until permanent market changes are approved and implemented

Principal Issues

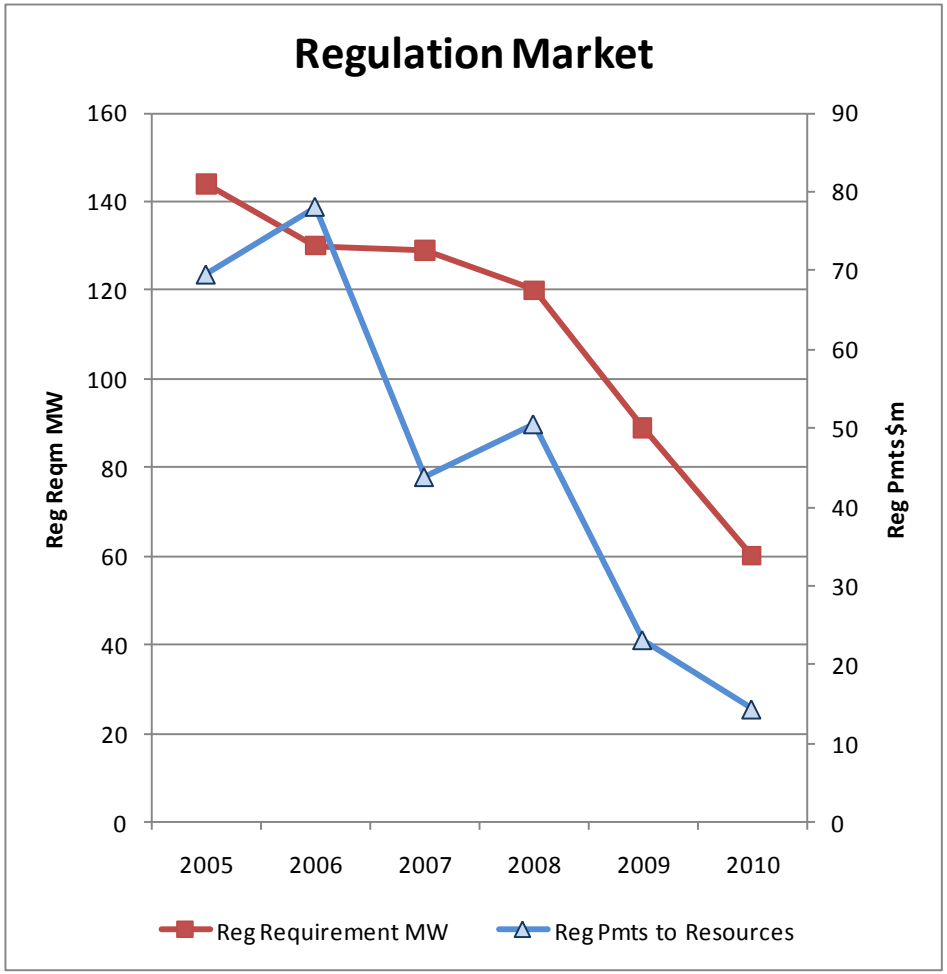
- Can these new technologies perform as advertised?
  - So far, the answer is yes
- What issues have been identified?
  - Managing state-of-charge for storage resources with limited energy storage (i.e. less than 2 hours)
  - Cost-effective metering and communications for geographically dispersed resources (electric vehicles, demand response)
- Benefits of “fast response” vs. “sustained response”
  - AGC dispatch sends new set points every 4 seconds
  - Many/most of the new technologies can move from top to bottom of their regulating range within a single 4-second cycle
  - NERC compliance criteria based on 15-minute intervals
- “Fast” is better than “slow”, but:
  - Faster response is unlikely to reduce noncompliance risk
  - Might allow reduced regulation requirement
  - Current New England requirement is ~65MW for a 28,000 MW summer peak system.

Impact of Response Rate



Factors Affecting Regulation Market Economics

- Late-2005
  - implemented service payment and separated resource-specific opportunity costs from the Regulation Clearing Price
- Early-2007
  - Bidders fully adjusted to market design
  - minor improvements in selection algorithm
- 2009
  - Reduction in requirements
  - Lower gas prices reduced opportunity costs
- Future?
  - Uniform clearing price
  - New technologies



Pilot Program – Interested Technologies

- Currently participating
  - Flywheels
  - Residential electric thermal storage
- Qualified to participate, but not online
  - NaS batteries
  - Commercial/industrial load control
  - HVDC power electronics
- Expressions of Interest
  - Lithium-ion batteries
  - Electric vehicles
  - Buoyancy energy storage
  - Wind-powered microgrid

Where Are We Heading?

- ISO-NE is moving to eliminate the “pilot” status and allow full participation of these new technologies in the regulation market
  - Timing mostly depends on scope of forthcoming rules related to FERC’s February 2011 Regulation NOPR
- May preserve the Pilot Program infrastructure as a technology sandbox
  - Innovation doesn’t occur on schedule
  - Will shorten or avoid delays related to stakeholder and regulatory processes
- Develop cost-effective approaches to metering and settlement to accommodate geographically dispersed “smart-grid” applications
  - Expensive solutions will be a significant barrier to entry

ISO-NE's Regulation Market - Design Improvement Goals

- Uniform clearing price that incorporates opportunity costs of the marginal resource
- Cost-effectively integrating limited energy storage resource
- Cost-effectively integrating geographically dispersed, aggregated resources
  - Examples: vehicle-to-grid, demand-response

Demand Response Reserves Pilot Program

Demand Response in Reserve Markets

- Demand Response is currently not eligible to provide reserves to the wholesale electric system
  - Dispatchable demands are eligible to provide reserves
- Demand Response Reserves Pilot started in 2006
- 50 MW test over a multi-year period to demonstrate performance during reserve activation events
- Can Demand Response provide a product similar to 10 and 30-minute spinning and non-spinning reserves?

Participating Asset Types

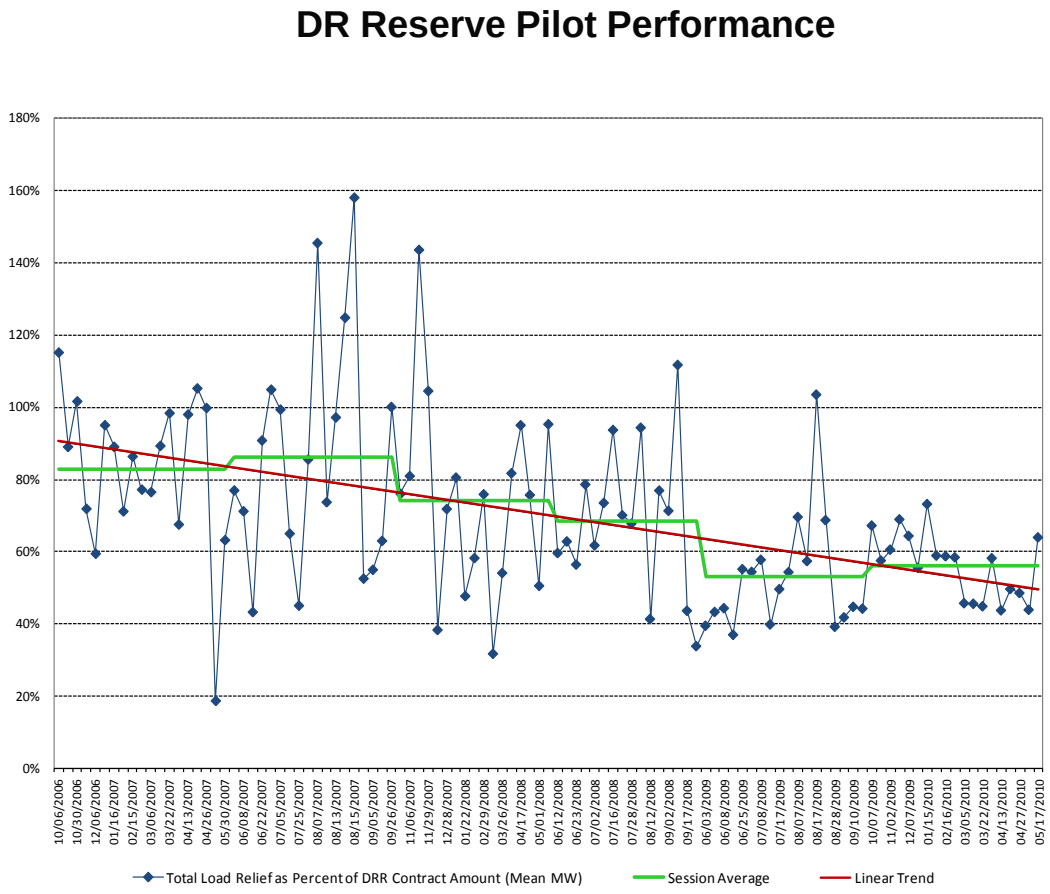
- **Load Reduction**
  - The most common load reduction technology/strategy included lighting and HVAC usage
  - Asset performance was assessed by comparing actual metered load during an event to an asset-specific estimated baseline
- **Behind-the-Meter Generation**
  - Asset performance assessed solely on the metered generation at the time of an event
- **Direct Load Control**
  - Centralized control of a specific end-use across a large number of small customers – e.g., residential air conditioner curtailment
  - Asset performance was assessed by comparing actual metered load during an event to a control group

Participating Industries

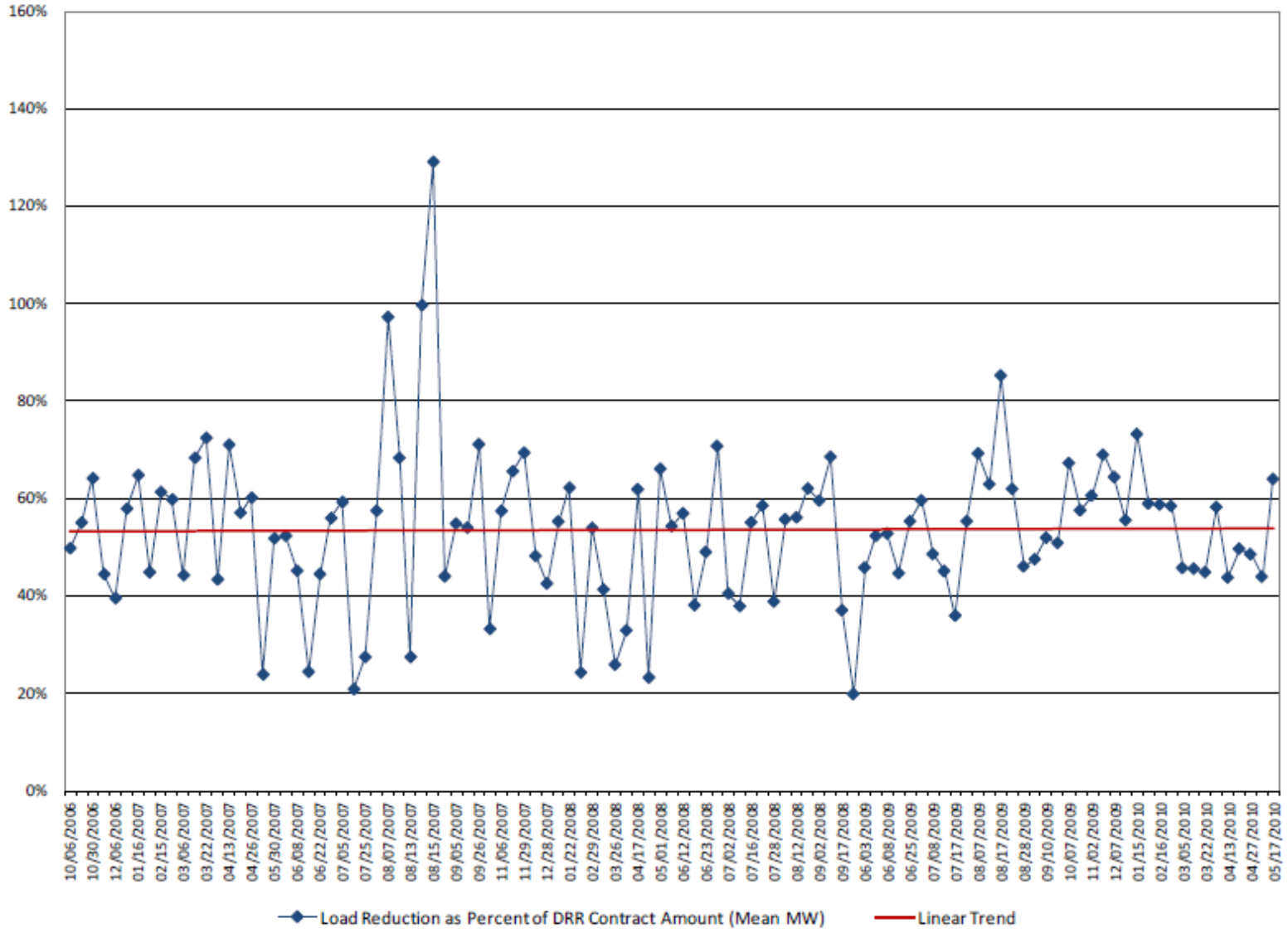
- Grocery Stores
- Manufacturing
- Large Retail
- Education Sector
- Wastewater Treatment Facilities
- Aggregated Air Conditioning Curtailment
- Behind-the-Meter Generators (regardless of their industry of origin)

Demand Response Reserves Pilot Summary

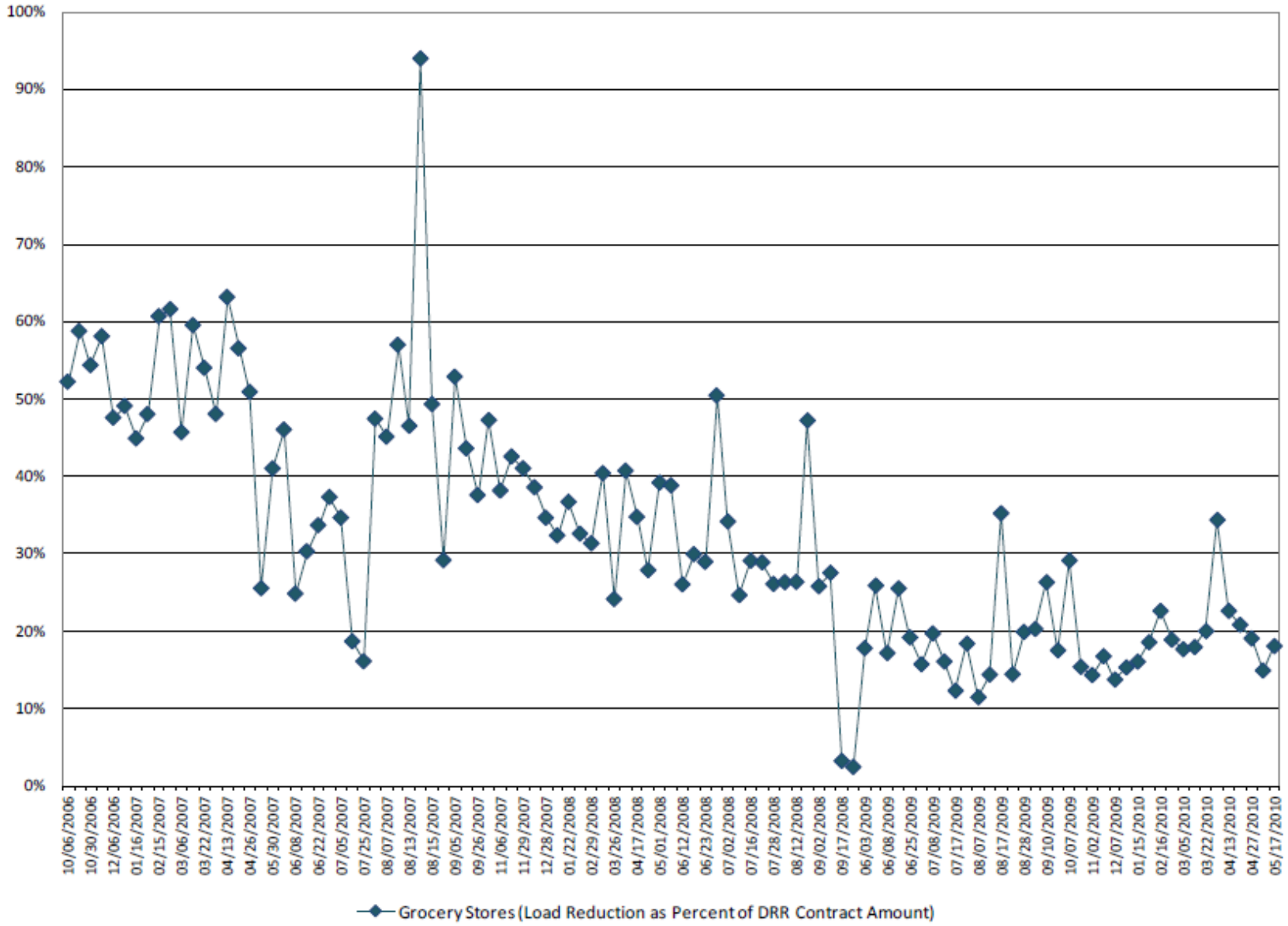
- Pilot ran from October 2006 to May 2010
  - Asset types include load reductions, Behind the Meter Generation, direct load control (i.e. aggregated air conditioner curtailment)
    - 109 assets participated in at least one season; 35 assets participated in all seasons
  - Assets enrolled in six seasons; 26.4 MW per season on average
  - 107 events



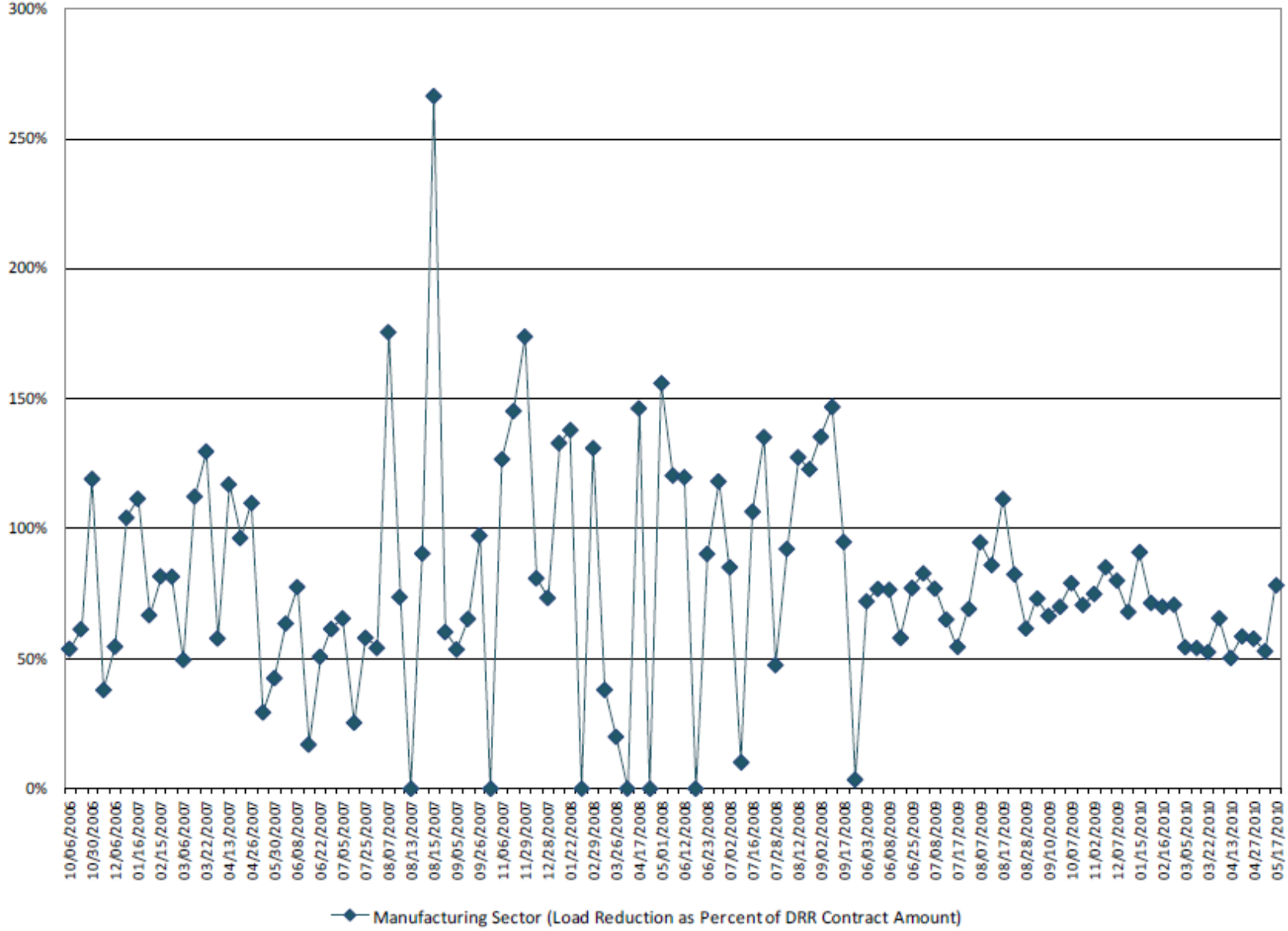
DRRP Performance of Load Reduction



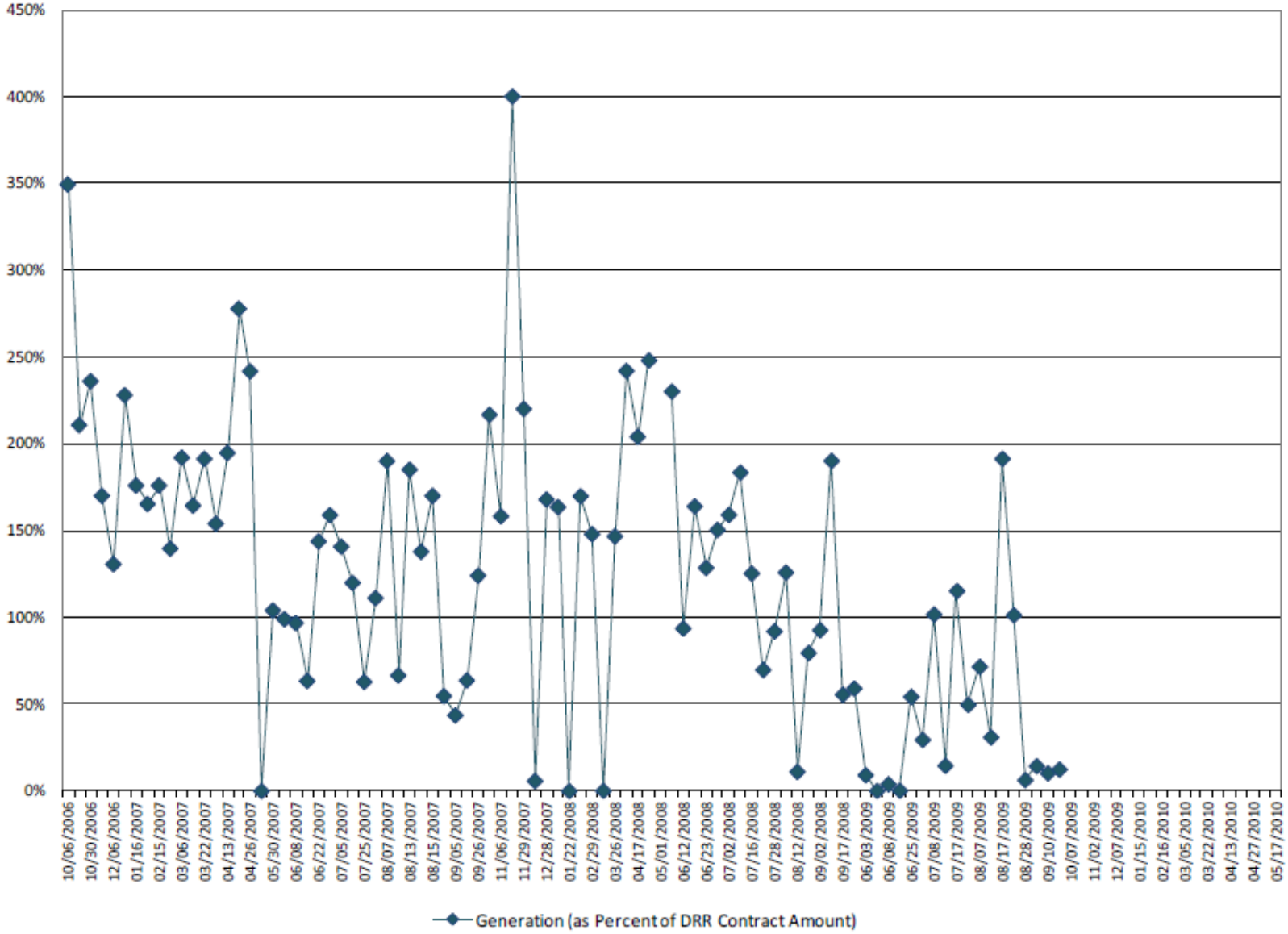
DRRP Performance of Grocery Stores



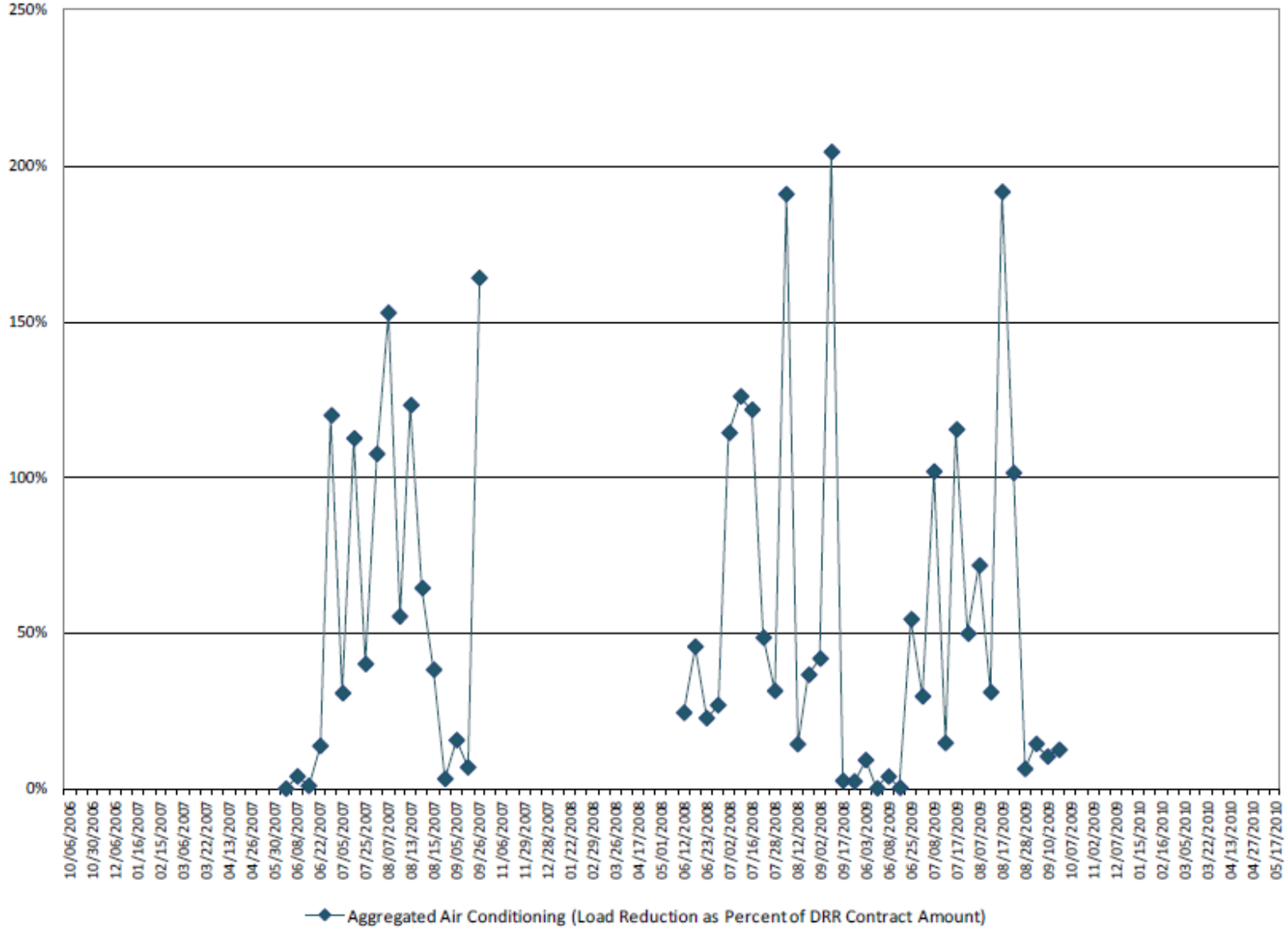
DRRP Performance of Manufacturing Facilities



DRRP Performance of Behind-the-Meter Generation



DRRP Performance of Direct Load Control
(Aggregated Residential Air Conditioning Curtailment)



Comparing the Performance of Pilot Program Assets and Generation Resources

- Participating pilot program assets showed less reliability than generation resources (i.e., in-front of meter generators)

- In-front-of-the-meter generation resources showed a moderate increase in reliability since the pilot program started, while pilot program assets showed a decrease in reliability during the same time frame

Recommendations for Further Research

- Investigate / implement:
  - Performance erosion
  - Audit day behavior
  - Weather-based performance metrics
  - Penalties for over-performance
  - Tools to assist asset providers to set goals and maintain performance
  - Change rules regarding re-submission of data
  - Special metering requirements for behind-the-meter generation assets