PJM Capacity Market
Evolution of Supply

Andrew Ott
Executive Vice President, Markets
IEA ELECTRICITY SECURITY ADVISORY PANEL
June 12, 2014

PJM as Part of the Eastern Interconnection

21% of U.S. GDP produced in PJM

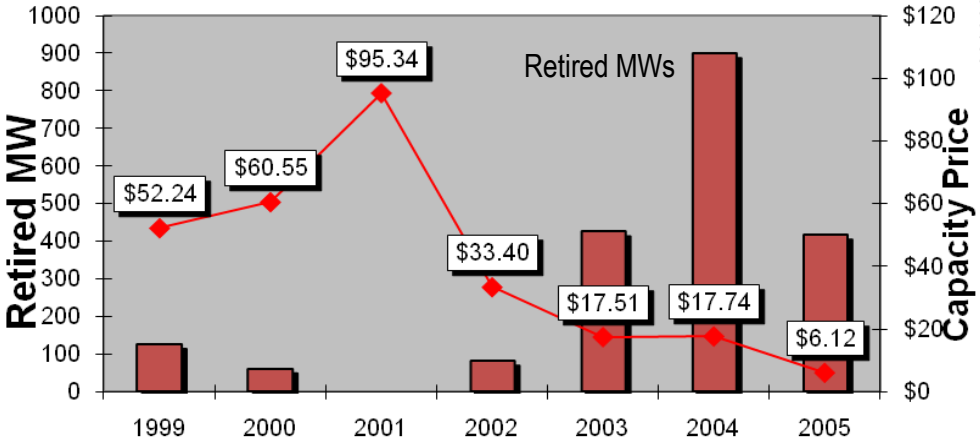
KEY STATISTICS

Member companies	900+
Millions of people served	61
Peak load in megawatts	165,492
MWs of generating capacity	183,604
Miles of transmission lines	62,556
2012 GWh of annual energy	793,679
Generation sources	1,376
Square miles of territory	243,417
States served	13 + DC

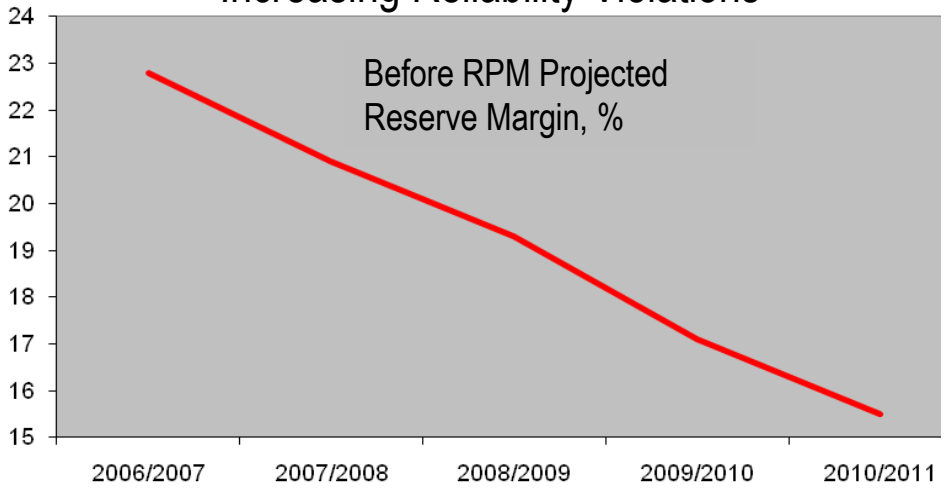
As of 6/1/2013

Driver for Capacity Market Reform in 2005

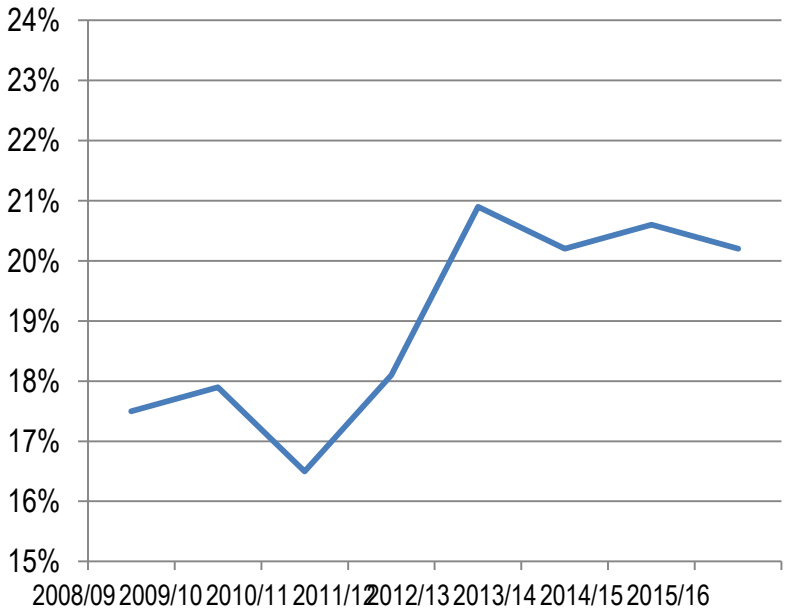
Decreasing Prices / Increasing Generation Retirement



Decreasing Reserve Margin / Increasing Reliability Violations

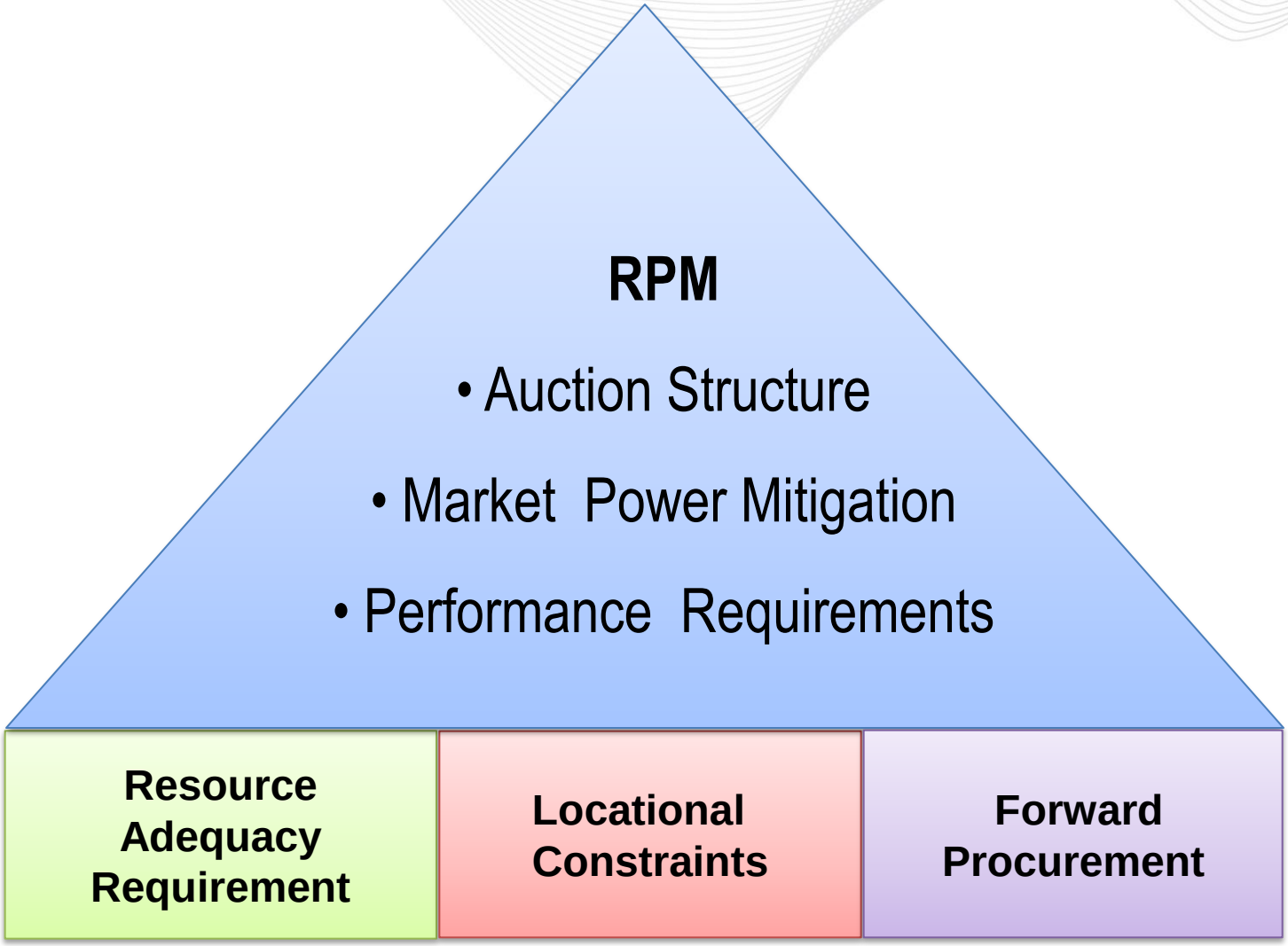


Installed Reserve Margin After RPM

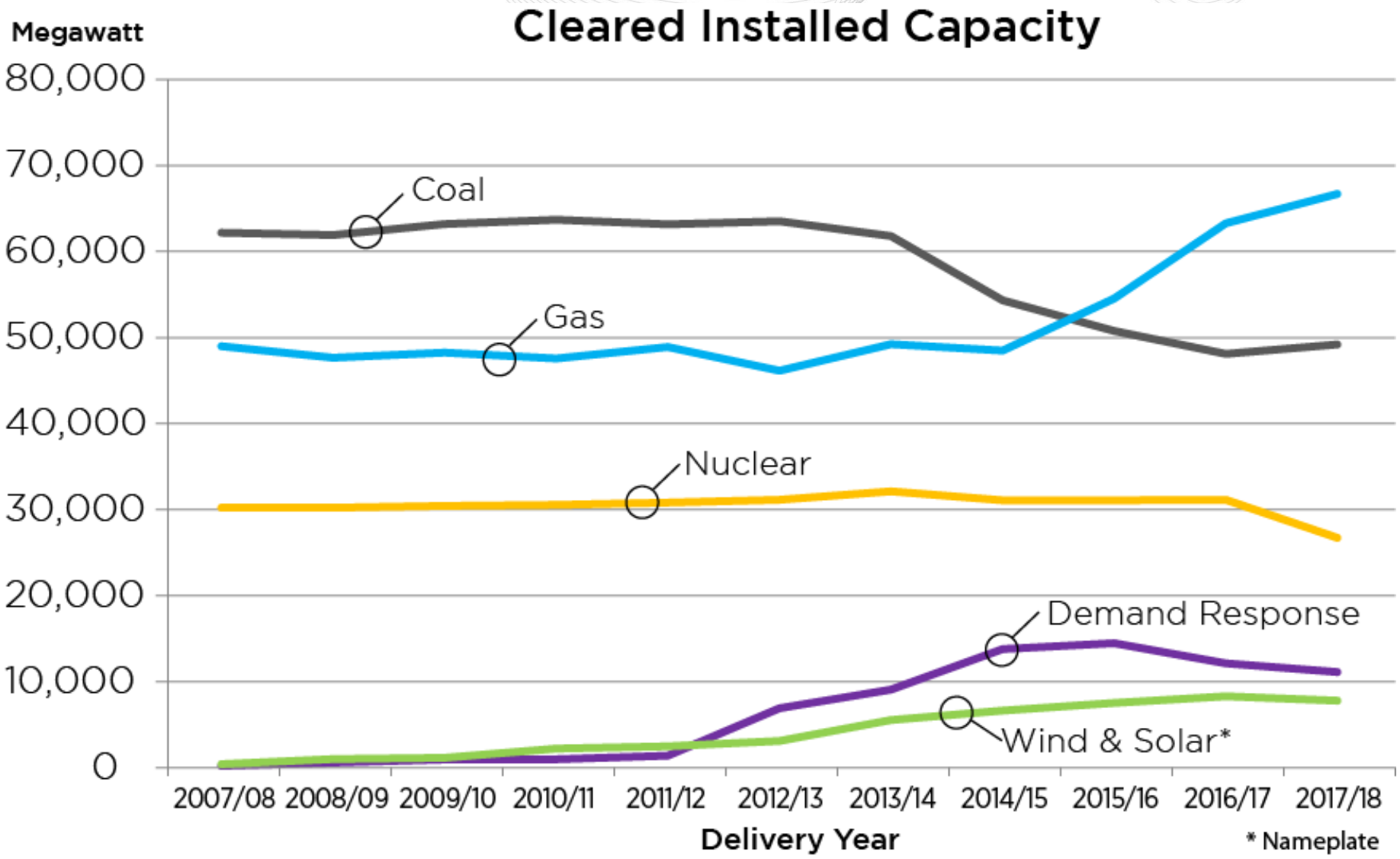


Reliability Pricing Model (RPM)

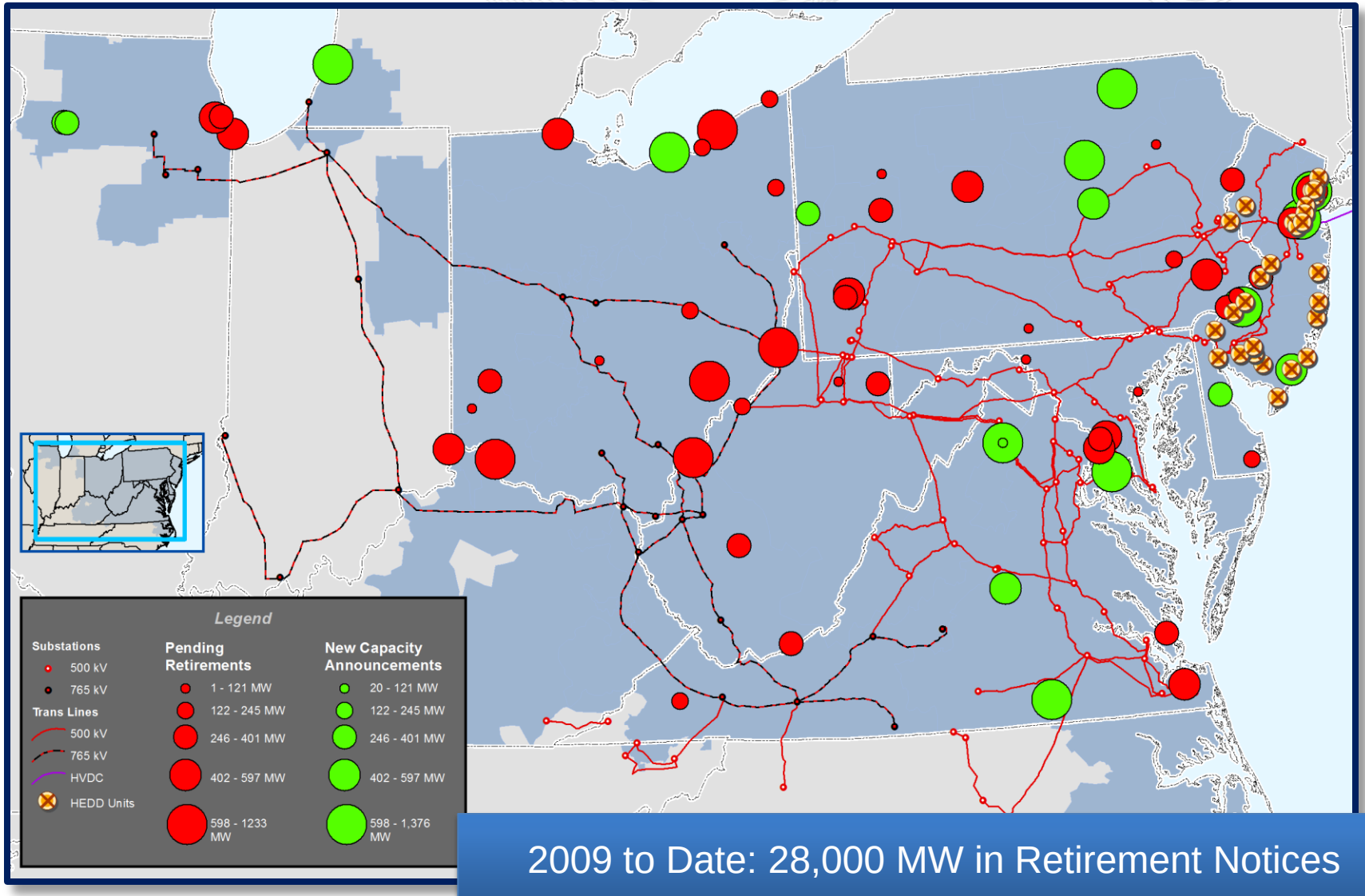
Foundation for Forward Capacity Market



Transformational Supply Evolution



Transitioning from Coal to Gas



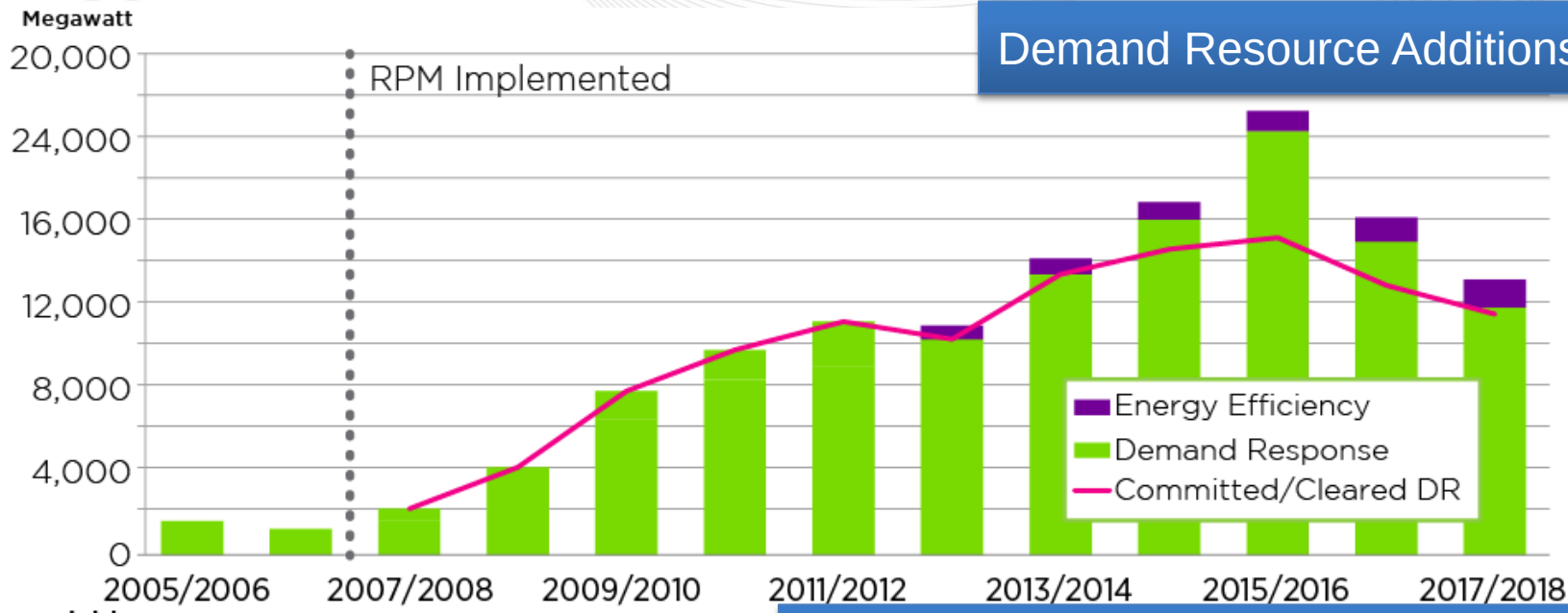
2009 to Date: 28,000 MW in Retirement Notices

Forward Capacity Market Performance Assessment – Primary Findings

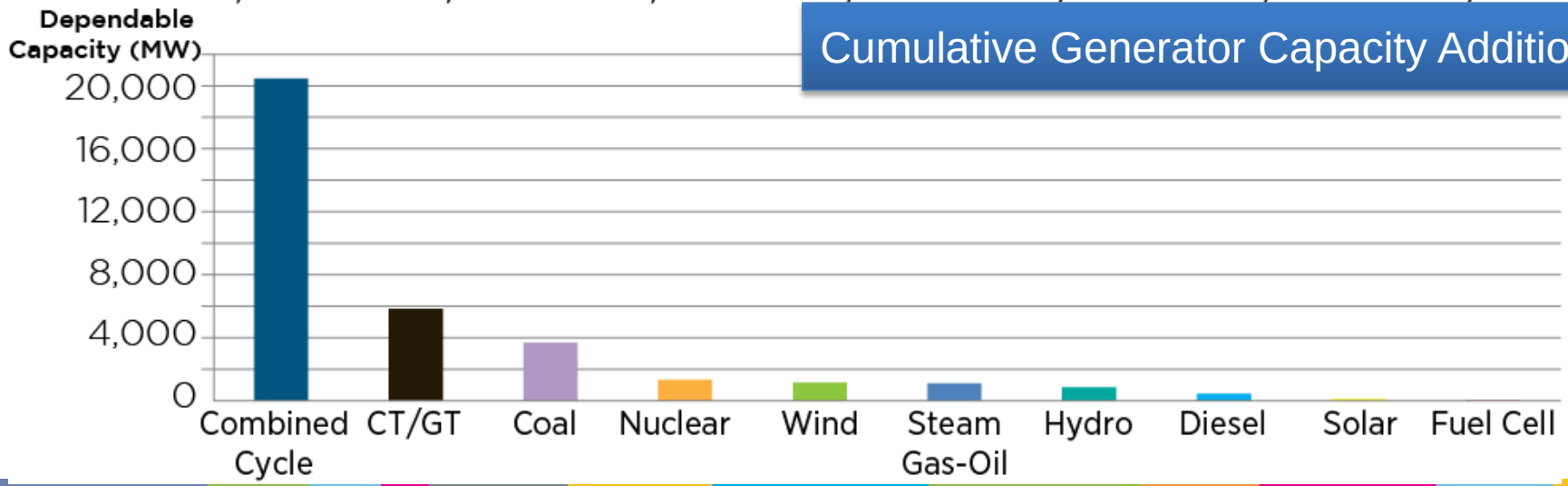
- RPM has achieved resource adequacy
  - RPM has attracted and retained sufficient capacity to meet or exceed reliability requirements
- Prices have been consistent with market conditions
  - Lower prices (below Net CONE) under excess supply conditions
  - Higher prices under tighter supply conditions, but still below Net CONE in recent auctions
- RPM has reduced costs by fostering competition
  - Generally level playing field has reduced costs by attracting investments in low-cost supplies from demand response, efficiency and uprates
- RPM has enabled cost-effective response to environmental rules
  - Facilitated economically efficient tradeoffs among investment in environmental retrofits, retirement and replacement with lower-cost alternative supplies

PJM Forward Capacity Market, 2007-2015

Demand Resource Additions



Cumulative Generator Capacity Additions



Industry Evolution

Evolution of Supply

- Traditional resources

Less flexible

- Renewable resources

Intermittent

- Less capability to provide power grid services

Evolution of Demand

- Technology enabled flexibility
- Alternative resource growth
- Enhanced capability to provide grid services

Market Evolution

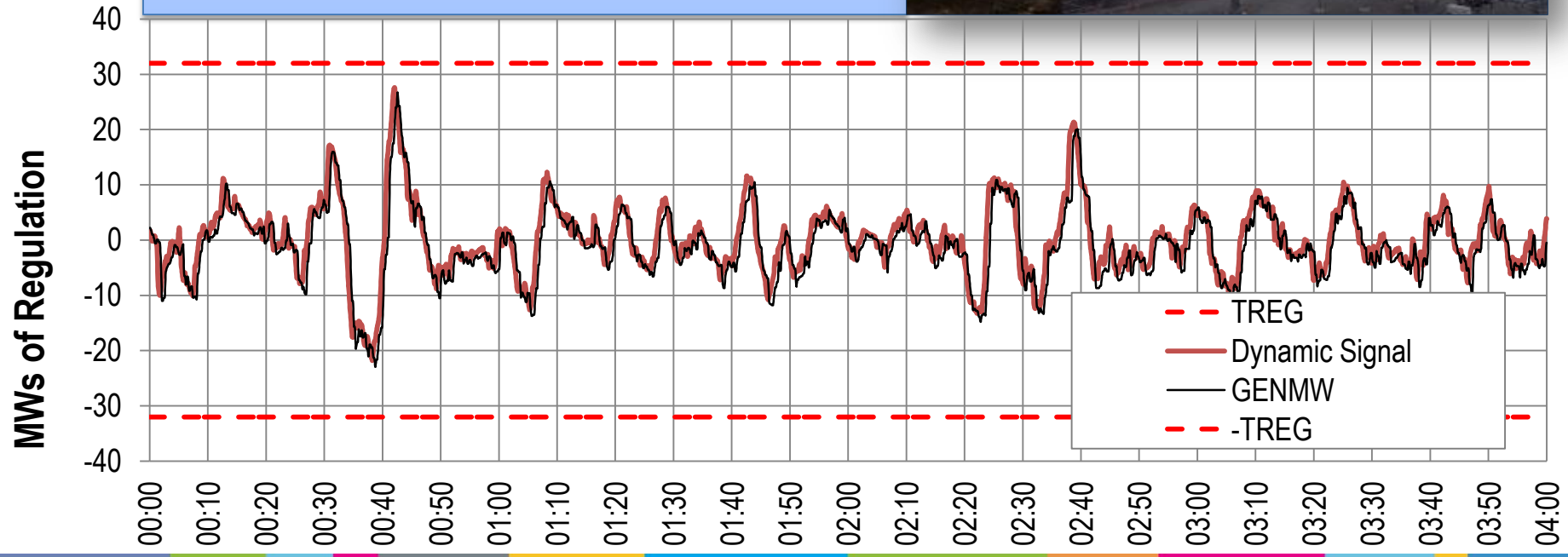
- Improvement in optimization and control systems
- More real-time markets to reward consumer flexibility
- Development of Forward Demand Response Control Signals

Evolution of Demand

- Trends
  - Increase in customer commitment to curtail demand or provide grid services during high price periods
  - Smart Grid Technology deployment
  - Retail rate innovation
- Operational Implications
  - Increase in customer response to price
  - Aggregated demand resources providing high quality grid services
  - In PJM, 9% of synchronized reserve is DR-based

Grid-Scale Energy Storage System – 32 MW Battery

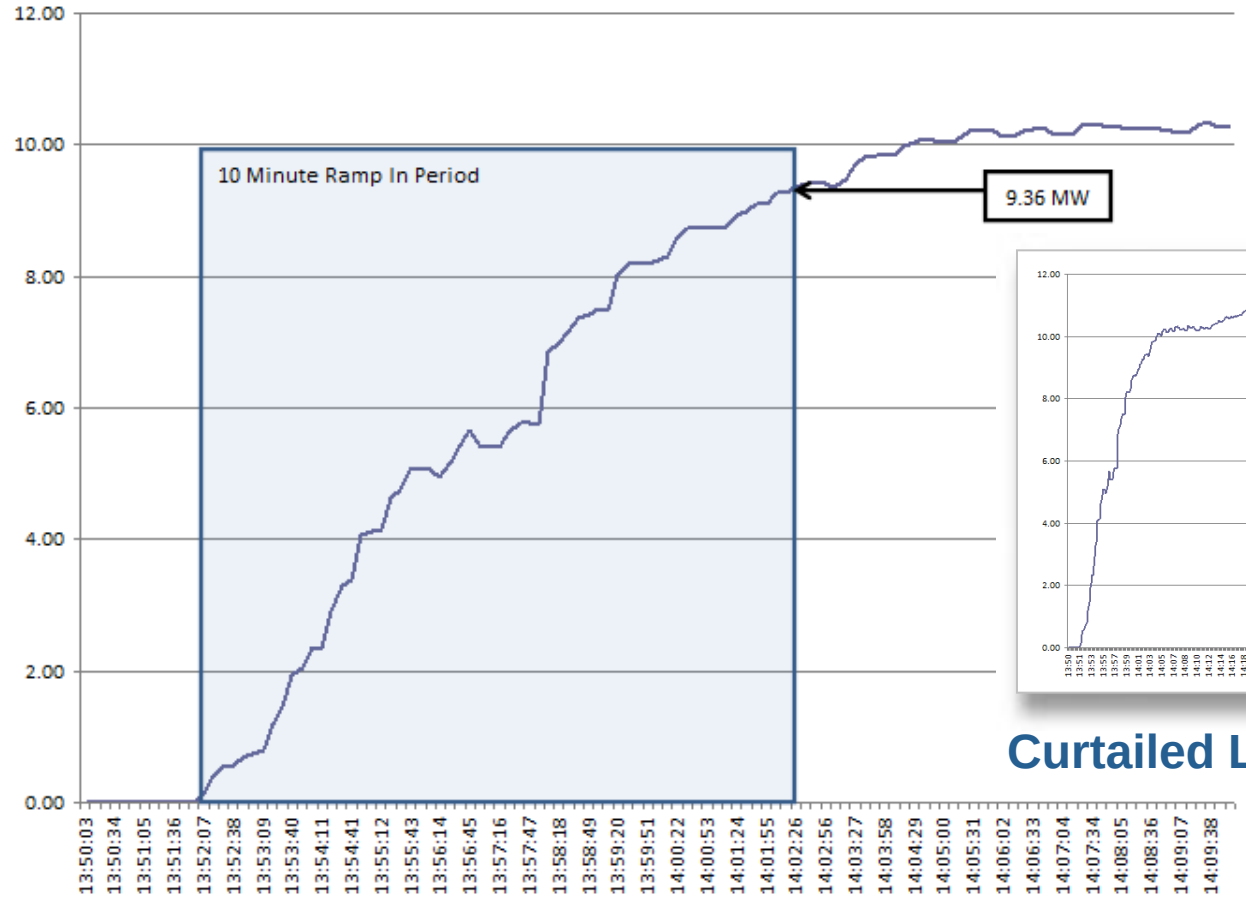
Laurel Mountain
Wind Farm
98 MW
61 turbines
Battery Storage
Lithium-ion (A123)
Power 32 MW, Energy 8 MWh

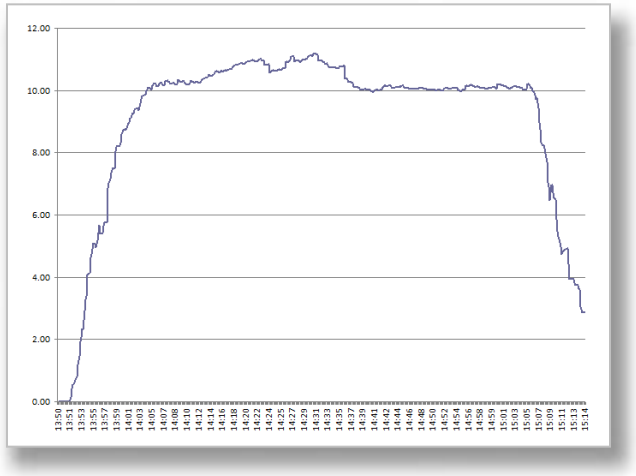


Aggregated Demand Resource Response to Synchronized Reserve Event

Aggregation 13,078 Residential Customers

Wireless Integrated Control Platform





Curtailed Load Event graph