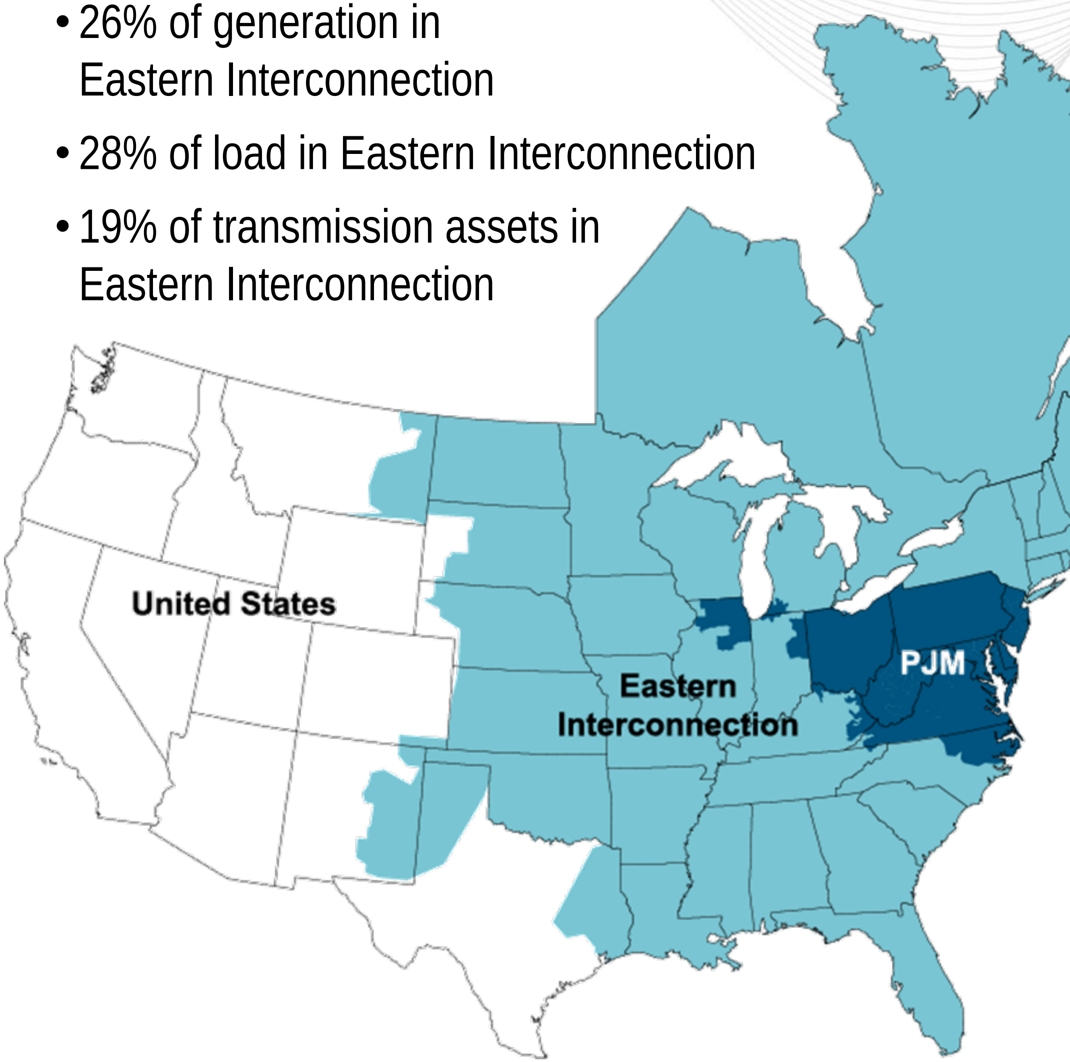
Renewable Integration in PJM: Wholesale Market Developments

Scott Baker
Business Solutions Analyst
PJM Interconnection

PJM as Part of the Eastern Interconnection

- 26% of generation in Eastern Interconnection
- 28% of load in Eastern Interconnection
- 19% of transmission assets in Eastern Interconnection



KEY STATISTICS	
PJM member companies	750+
millions of people served	60
peak load in megawatts	163,848
MWs of generating capacity	185,600
miles of transmission lines	65,441
GWh of annual energy	832,331
generation sources	1,365
square miles of territory	214,000
area served	13 states + DC
Internal/external tie lines	142

21% of U.S. GDP produced in PJM

As of 1/4/2012

PJM States with RPS

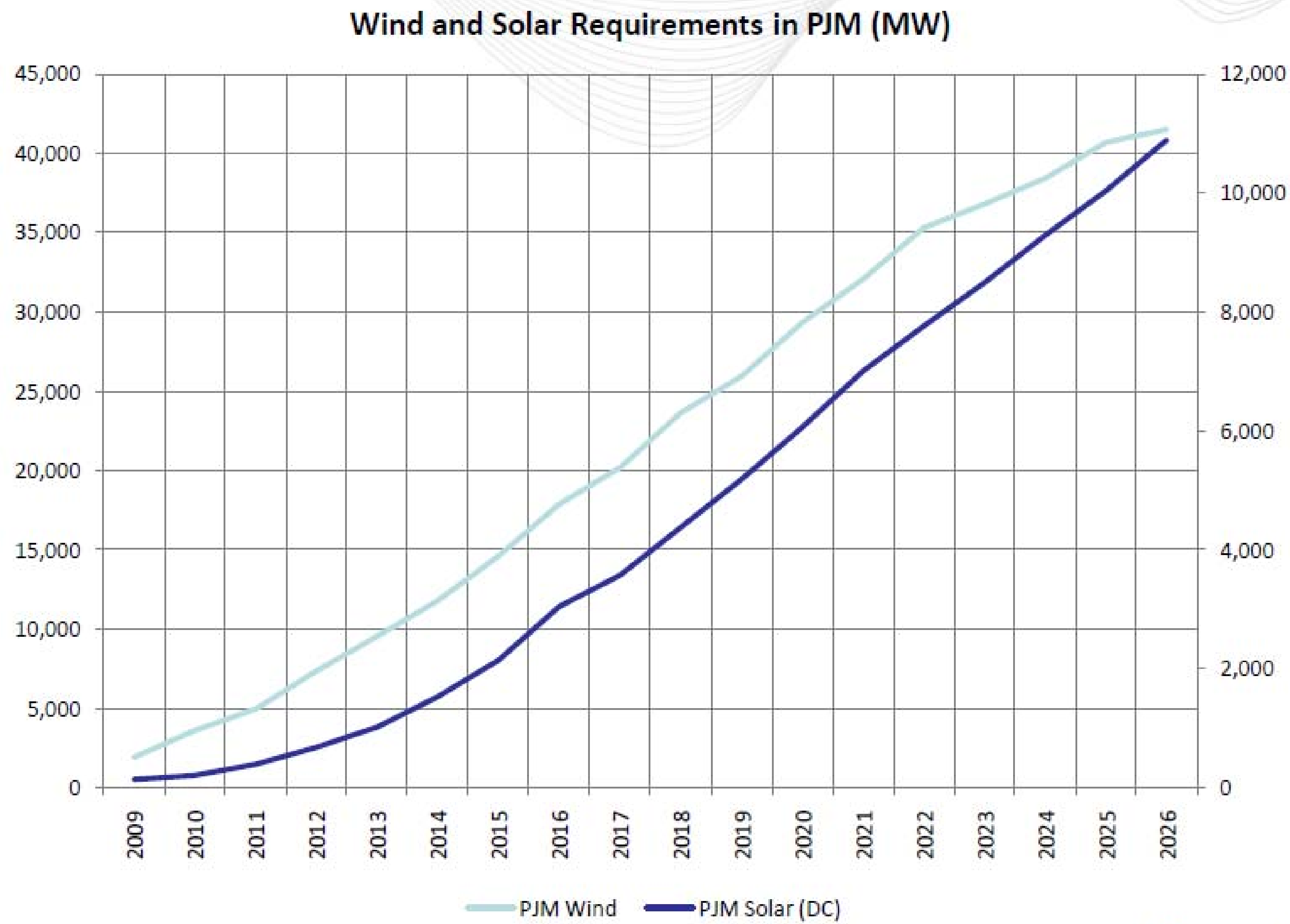
State Renewable Portfolio Standards (RPS) require suppliers to utilize wind and other renewable resources to serve an increasing percentage of total demand.

State RPS Targets:

- ☼ NJ: 22.5% by 2021
- ☼ MD: 20% by 2022
- ☼ DE: 25% by 2026
- ☼ DC: 20% by 2020
- ☼ PA: 18%** by 2020
- ☼ IL: 25% by 2025
- ☼ OH: 25%** by 2025
- ☼ NC: 12.5% by 2021 (IOUs)
- MI: 10% + 1,100 MW by 2015
- VA: 15% by 2025
- WV: 25%** by 2025

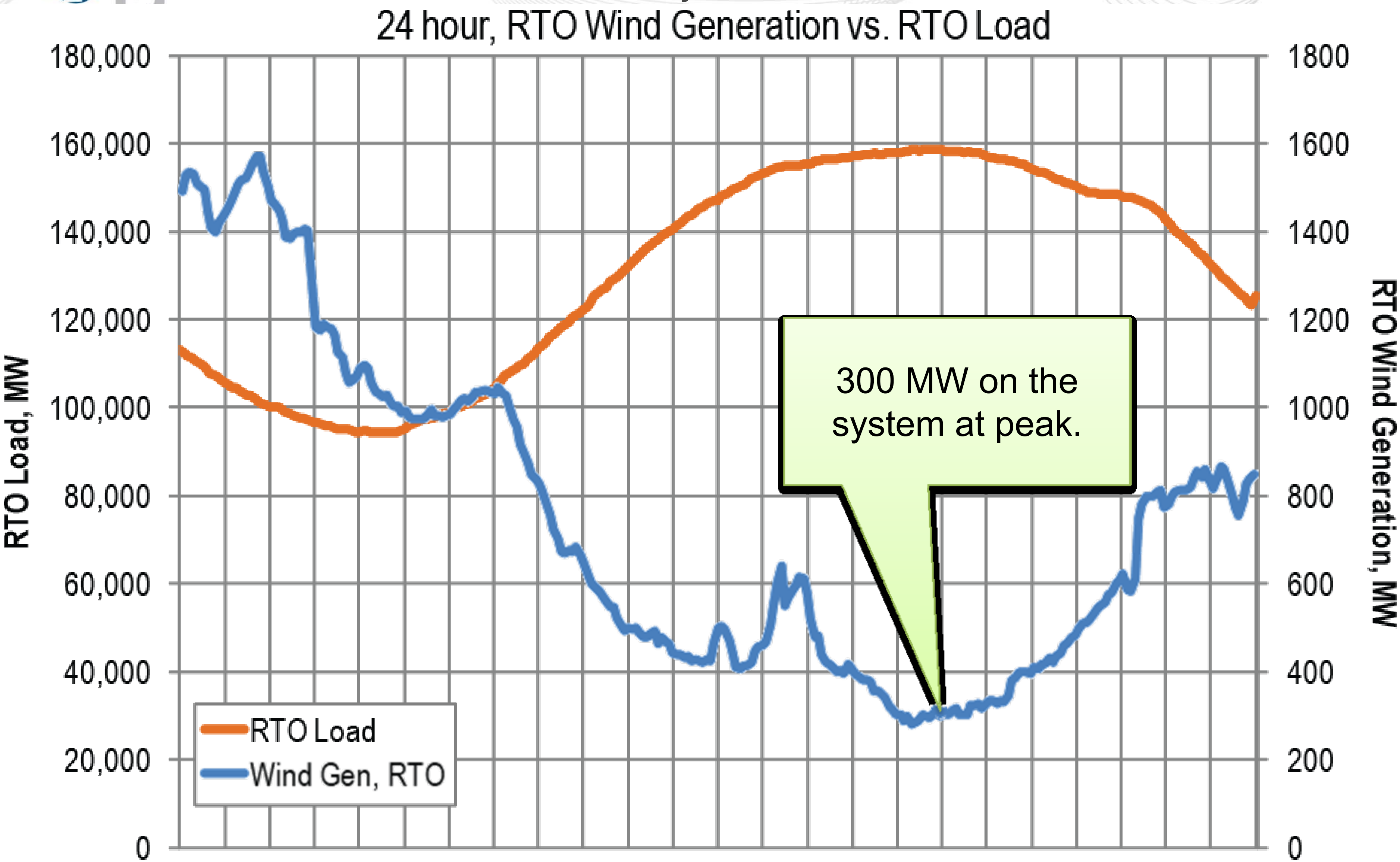
☼ Minimum solar requirement
** Includes separate tier of "alternative" energy resources

Wind and Solar Required



Assumes a 30% cap factor for wind
Assumes a 12% cap factor for solar

July 21, 2011 – PJM New All-Time Peak



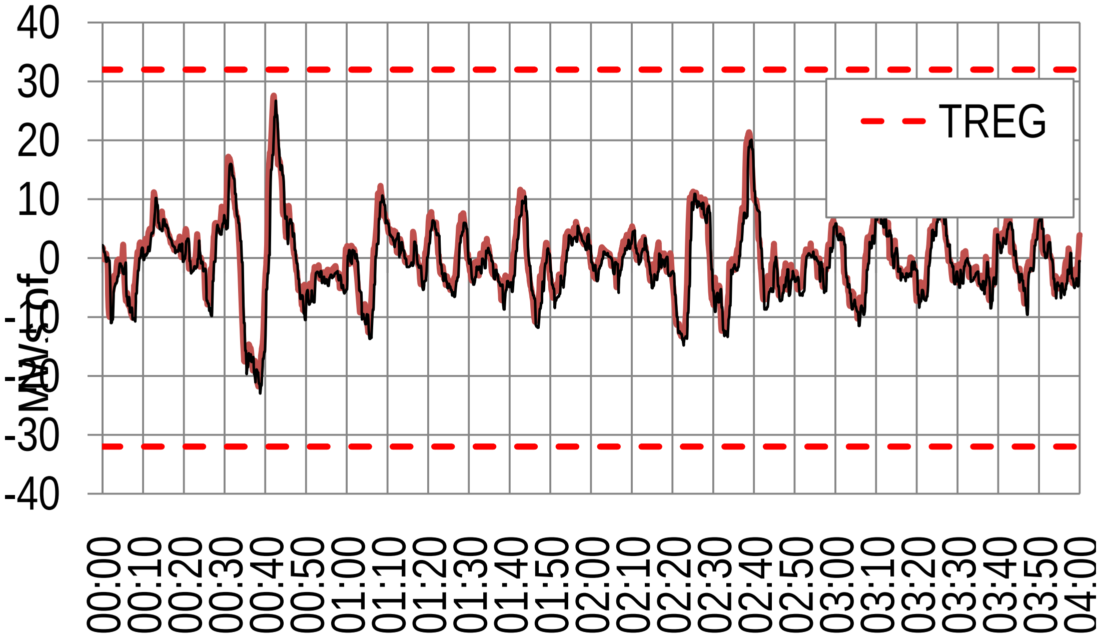
REGULATION MARKET CHANGES

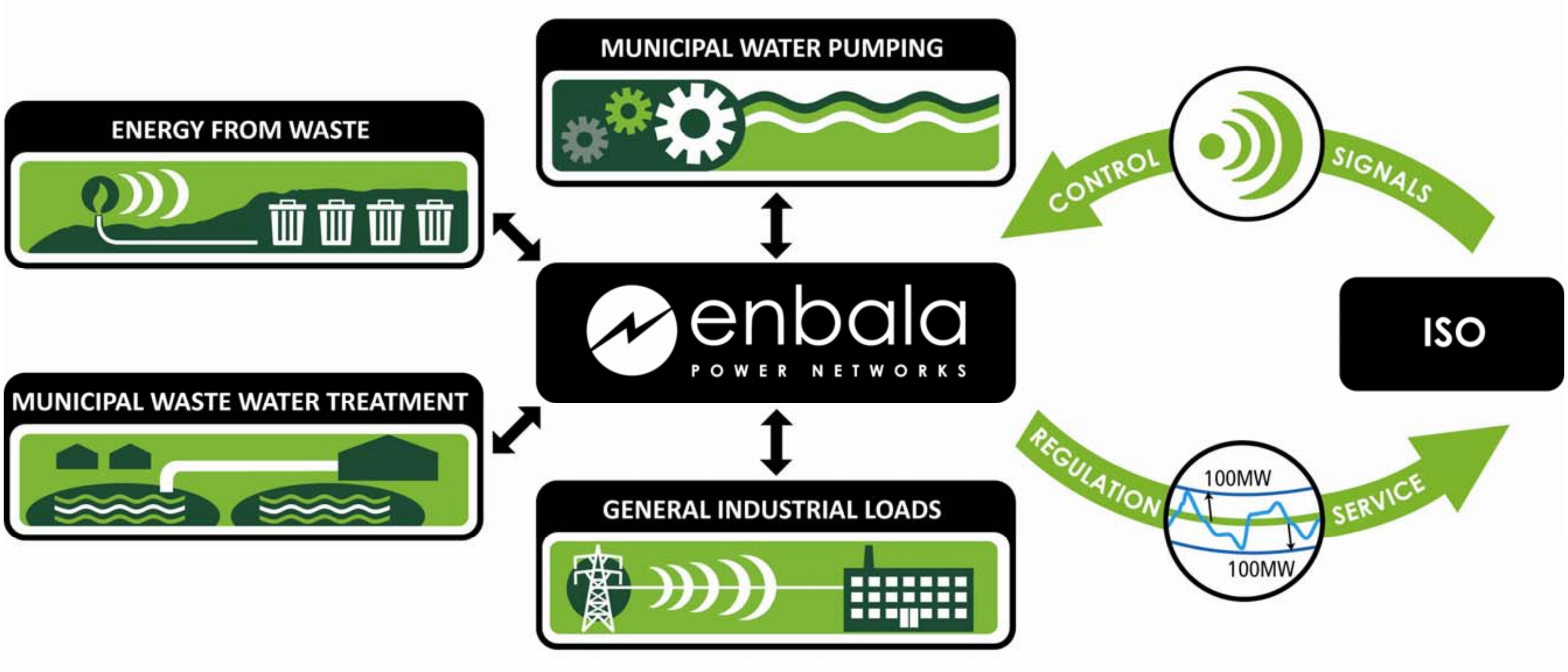
Why change the Regulation Market: Big picture

- Renewable Integration
  - By 2026, 14% of PJM’s energy comes from non-dispatchable, variable resources
    - Increase stochastic operating parameters, increase the need for primary reserves
- Market Efficiency
  - Increase competition; increase system control with less MWs
- The transition to cost-effective storage…

- New “Dynamic Regulation” signal
  - Based on total ACE but calculated to be energy neutral on average and highly correlated to system frequency
- Performance-based Regulation
  - Alignment of compensation with benefit to system control
- Lower Regulation capacity requirement
  - 1 MW > 500 kW > 100 kW
- Sub-metering for DR Regulation
- New CSP Registration – “Regulation Only”
  - Allows flexible market participation with same DR site

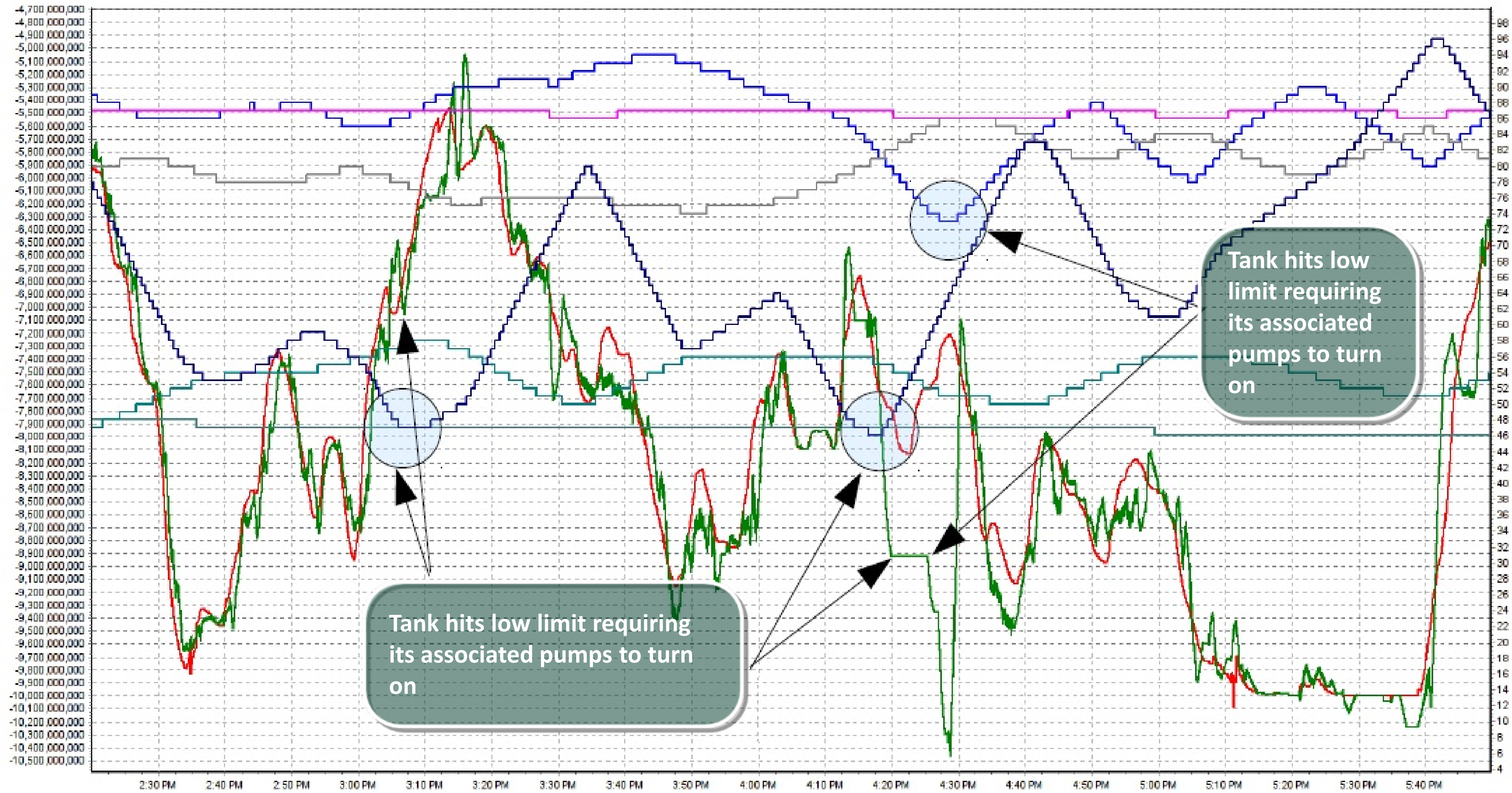
- AES Laurel Mtn.
  - 98 MW wind, 32 MW (8 MWh) battery



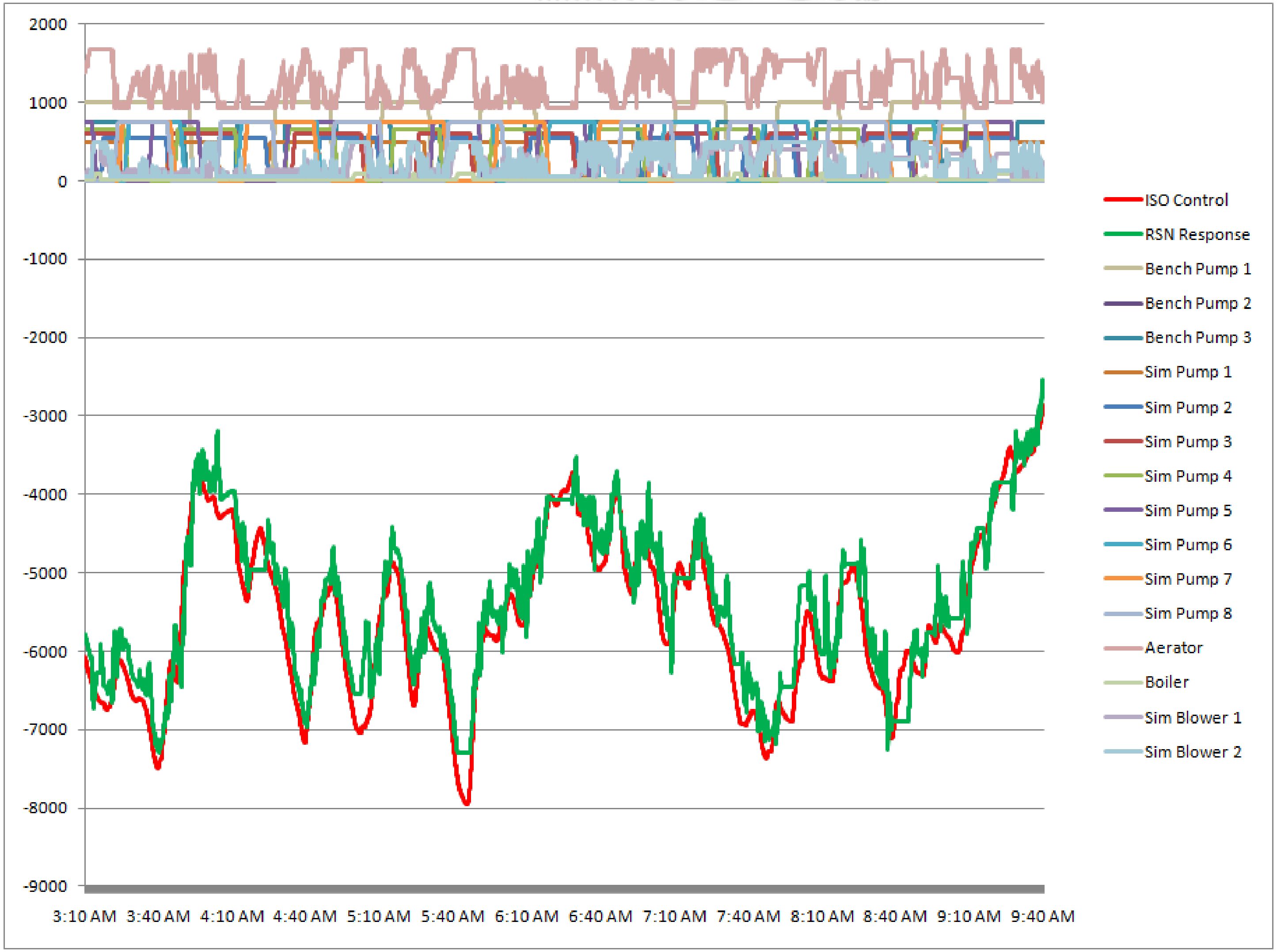


ENBALA's Power Network (EPN)

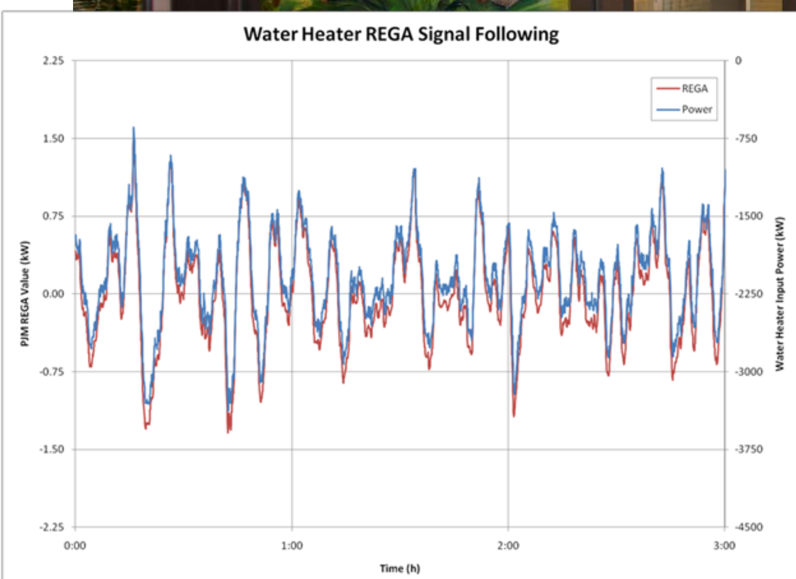
Waste Water Treatment Pumps



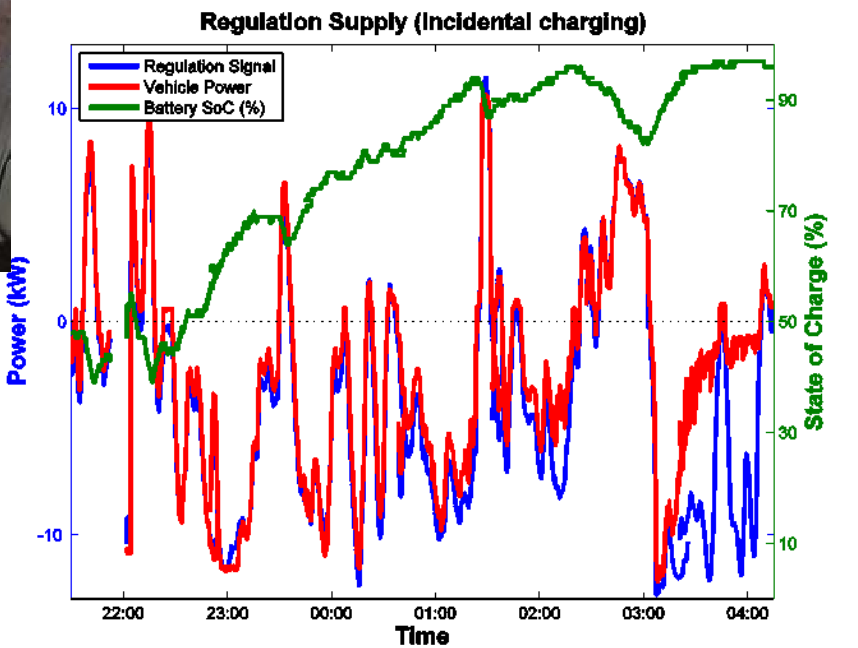
ENBALA, Aggregated Response to AGC




STEFFES
Heating Systems
Grid-Interactive Water Heater Control
Marathon
WATER HEATERS
pjm
ENERGYGUIDE


Water Heater REGA Signal Following
REGA
Power
2.25
1.50
0.75
0.00
-0.75
-1.50
-2.25
0
-750
-1500
-2250
-3000
-3750
-4500
0:00
1:00
2:00
3:00
PJM REGA Value (kW)
Water Heater Input Power (kW)
Time (h)

Other new technologies…



- Vehicle-to-Grid
- Distributed *and* mobile

Questions…