DOE Workshop: Load Participation in Capacity and Ancillary Services Markets

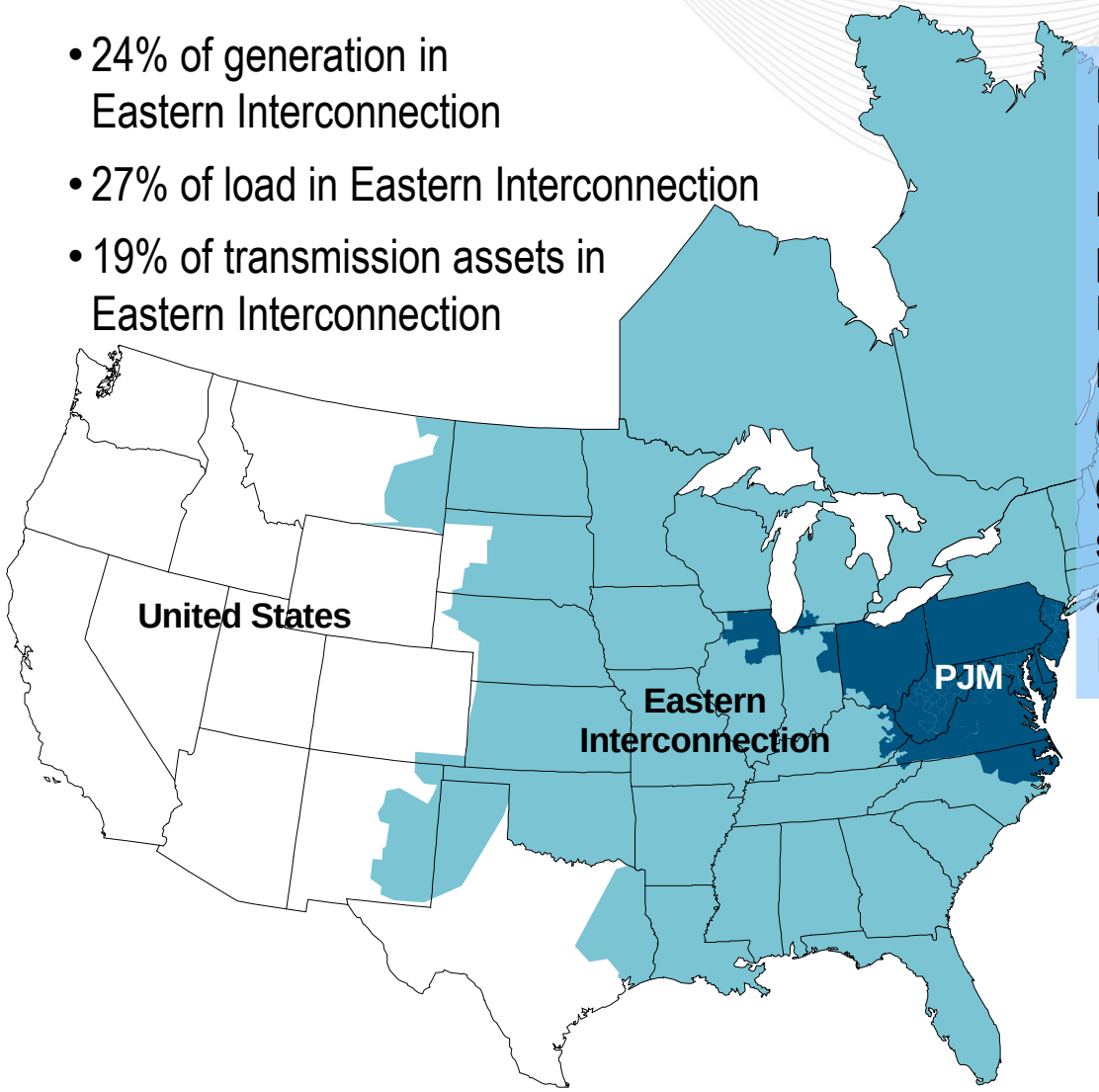
Terry Boston

President & CEO
PJM Interconnection

October 26, 2011

PJM as Part of the Eastern Interconnection

- 24% of generation in Eastern Interconnection
- 27% of load in Eastern Interconnection
- 19% of transmission assets in Eastern Interconnection



KEY STATISTICS

PJM member companies	710+
millions of people served	58
peak load in megawatts	158,450
MWs of generating capacity	180,400
miles of transmission lines	61,200
GWh of annual energy	794,335
generation sources	1,365
square miles of territory	211,000
area served	13 states + DC
Internal/external tie lines	142

20% of U.S. GDP produced in PJM

As of 7/21/2011

Predictions of Power Efficiency Gains

"Improving energy efficiency in the buildings-and-appliances and industrial sectors could (assuming substantial barriers can be addressed) offset some 85 percent of the projected incremental demand for electricity over the next 25 years."

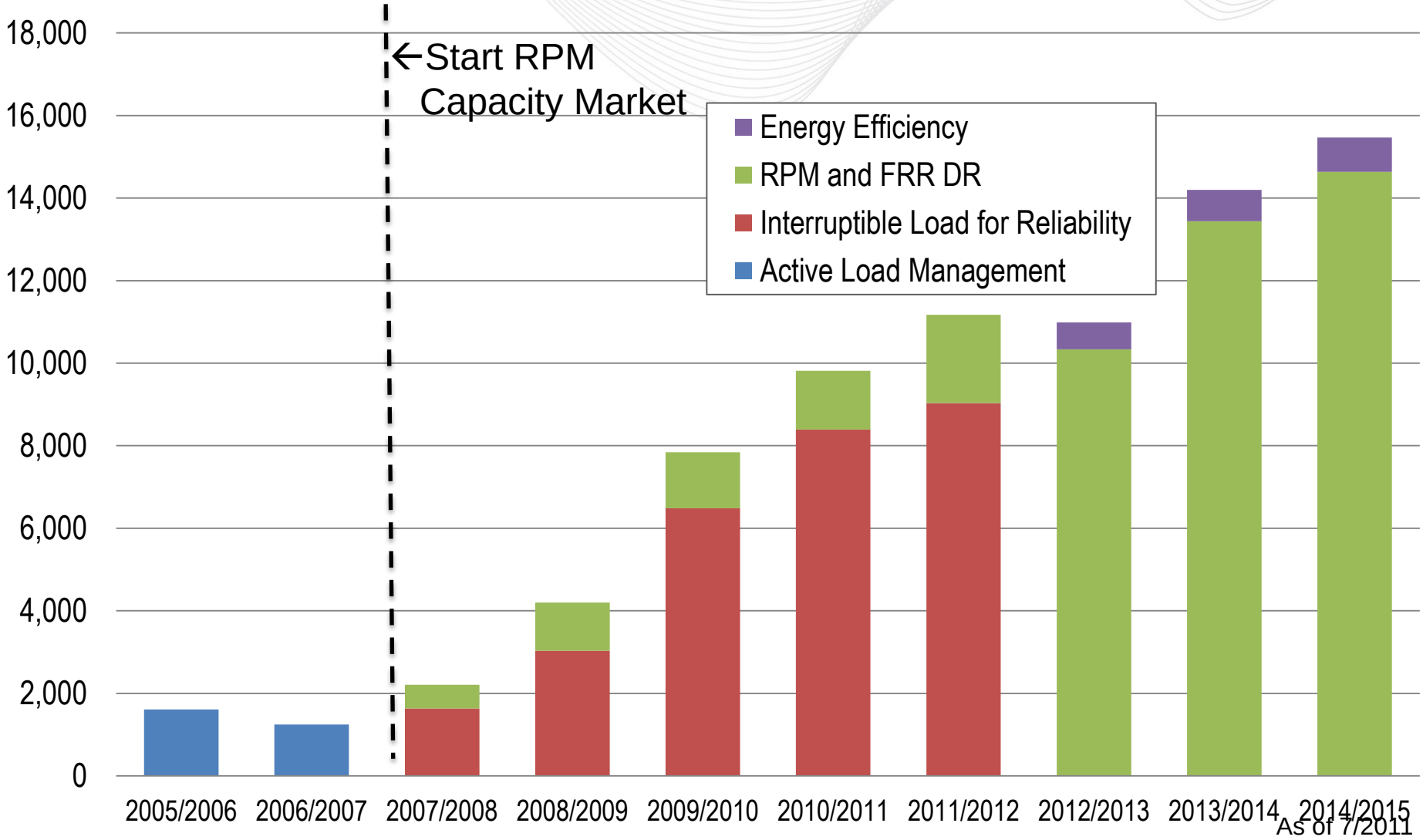
McKinsey Report, 2007

"Electricity conservation has come of age and it is less expensive to save electricity than to use it. New light bulbs and other electricity-saving devices will reduce power consumption [growth] by 80 to 90 percent—eliminating the need for new power plants and requiring the closure of many existing ones."

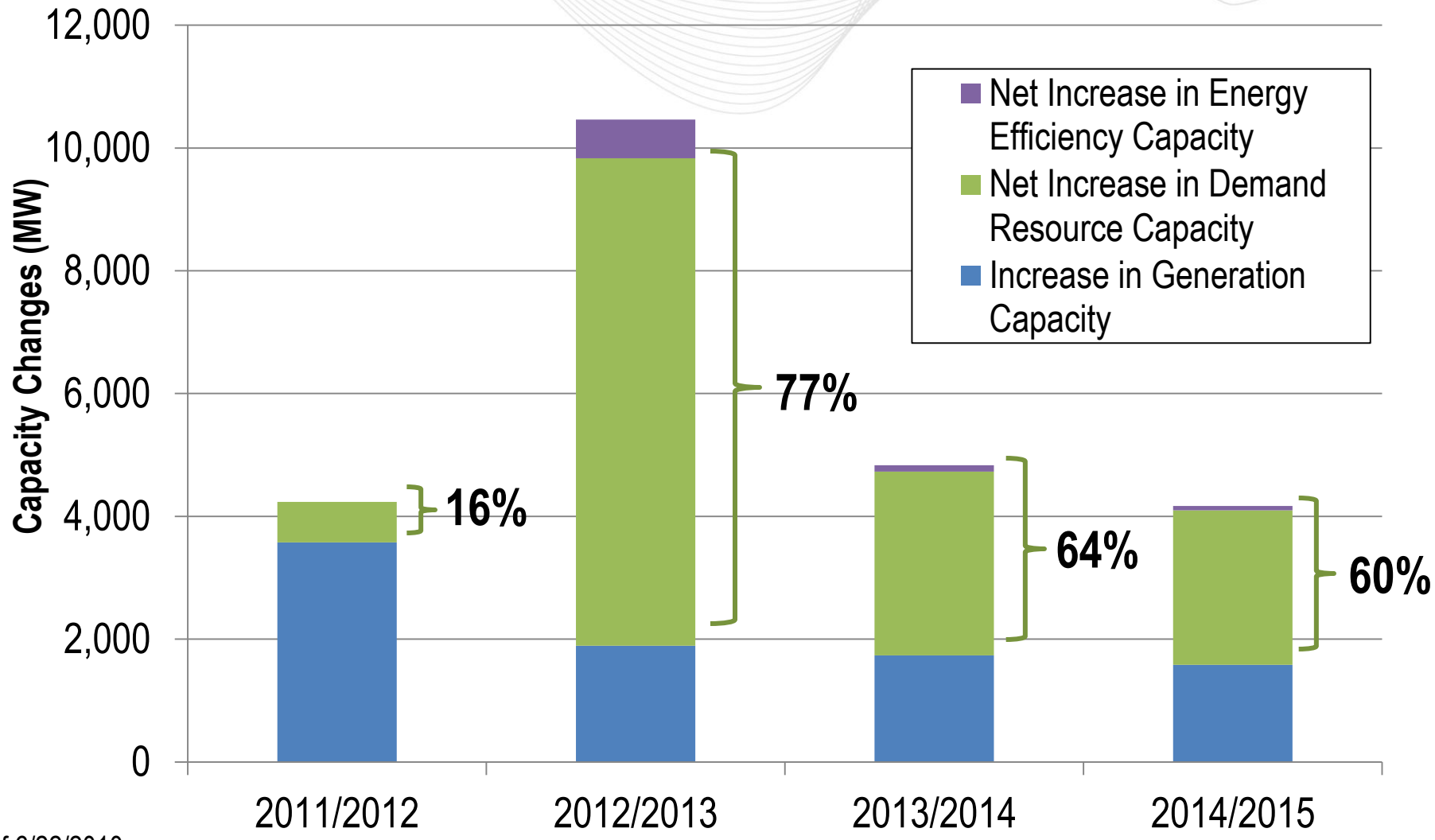
Business Week, 1984

Source: IHS Cambridge Energy Research Associates.

Offers of Demand-Side Resources as Capacity in PJM by Delivery Year



PJM Incremental Capacity Resource Additions



As of 6/22/2010

Demand Resource in the Capacity Market-2014/2015

Demand Resources

14,118 MW or enough power for 5 million people or half the number of households in the state of Michigan

Energy Efficiency

822 MW or enough to power 149,000 households about the number of households in the city of Cleveland, Ohio

PJM Alternative Technology Resource Pilot Program

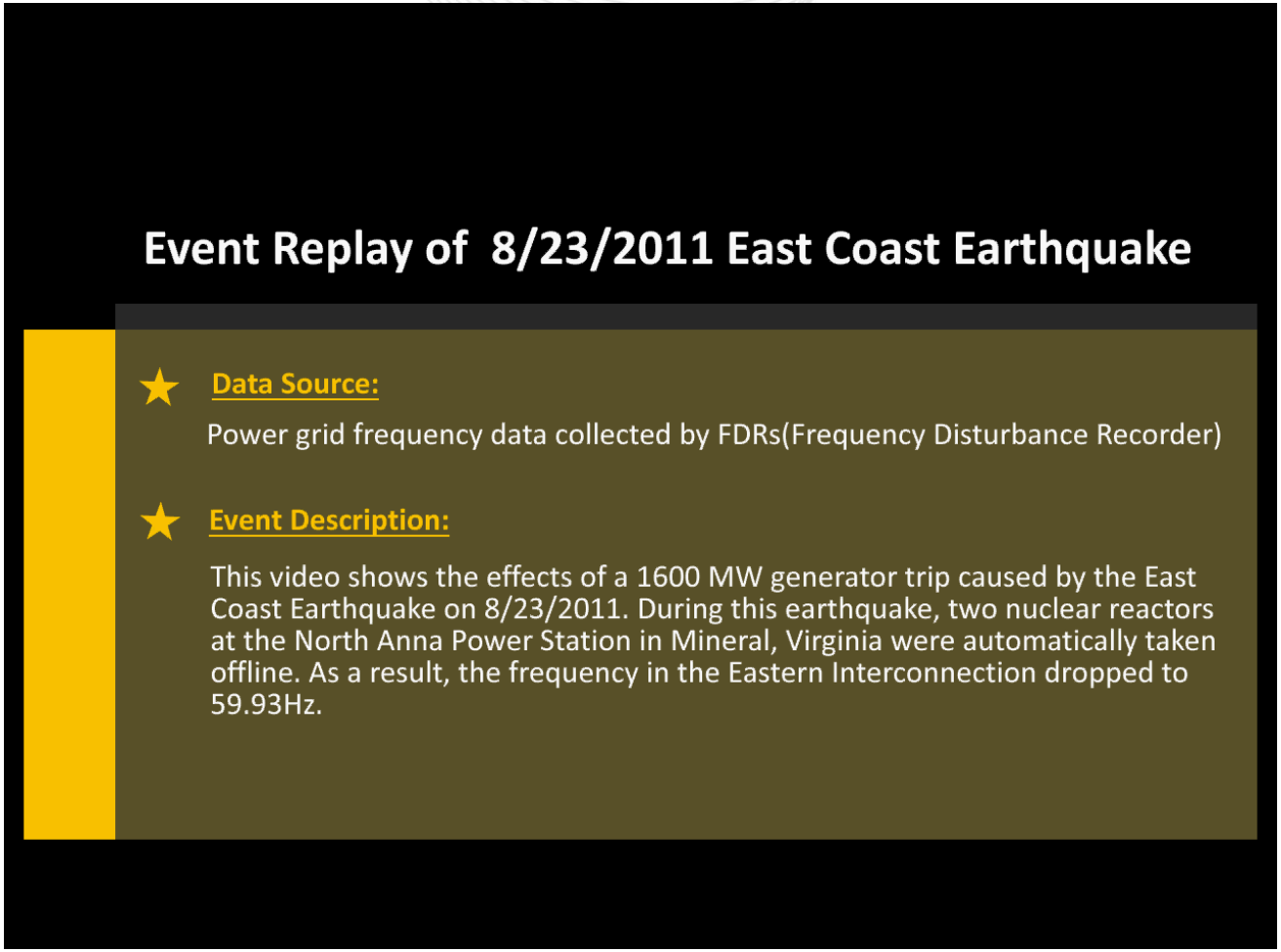
- With diversified technologies participating in the program, it has become an open window to demonstrate PJM's continuous efforts and great achievements in building an innovative company

http://www.pjm.com/markets-and-operations/alt-tech-resource-pilots.aspx

Summer 2011

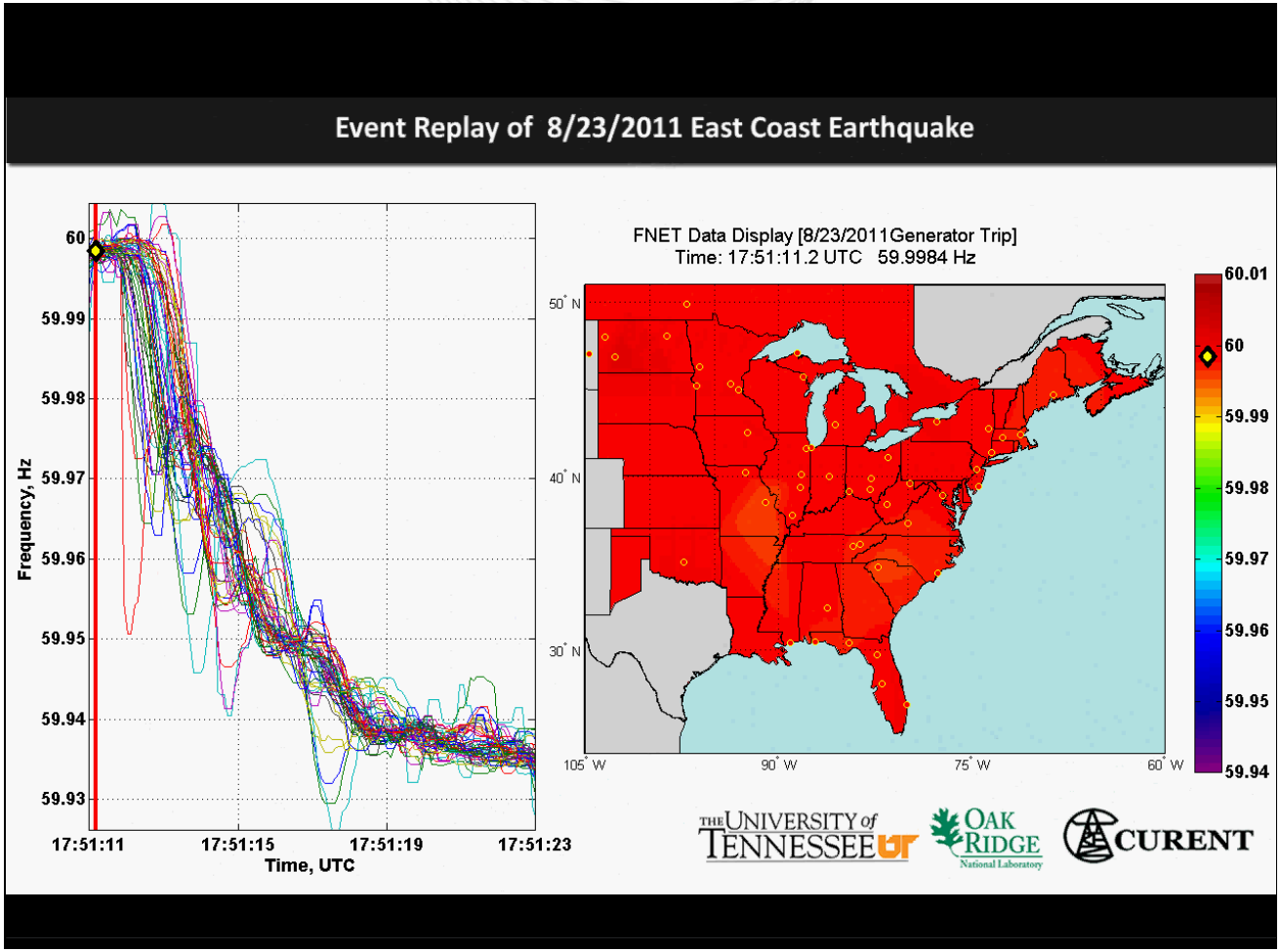
Shake and Bake

August 23, 2011 Earthquake Near Richmond VA



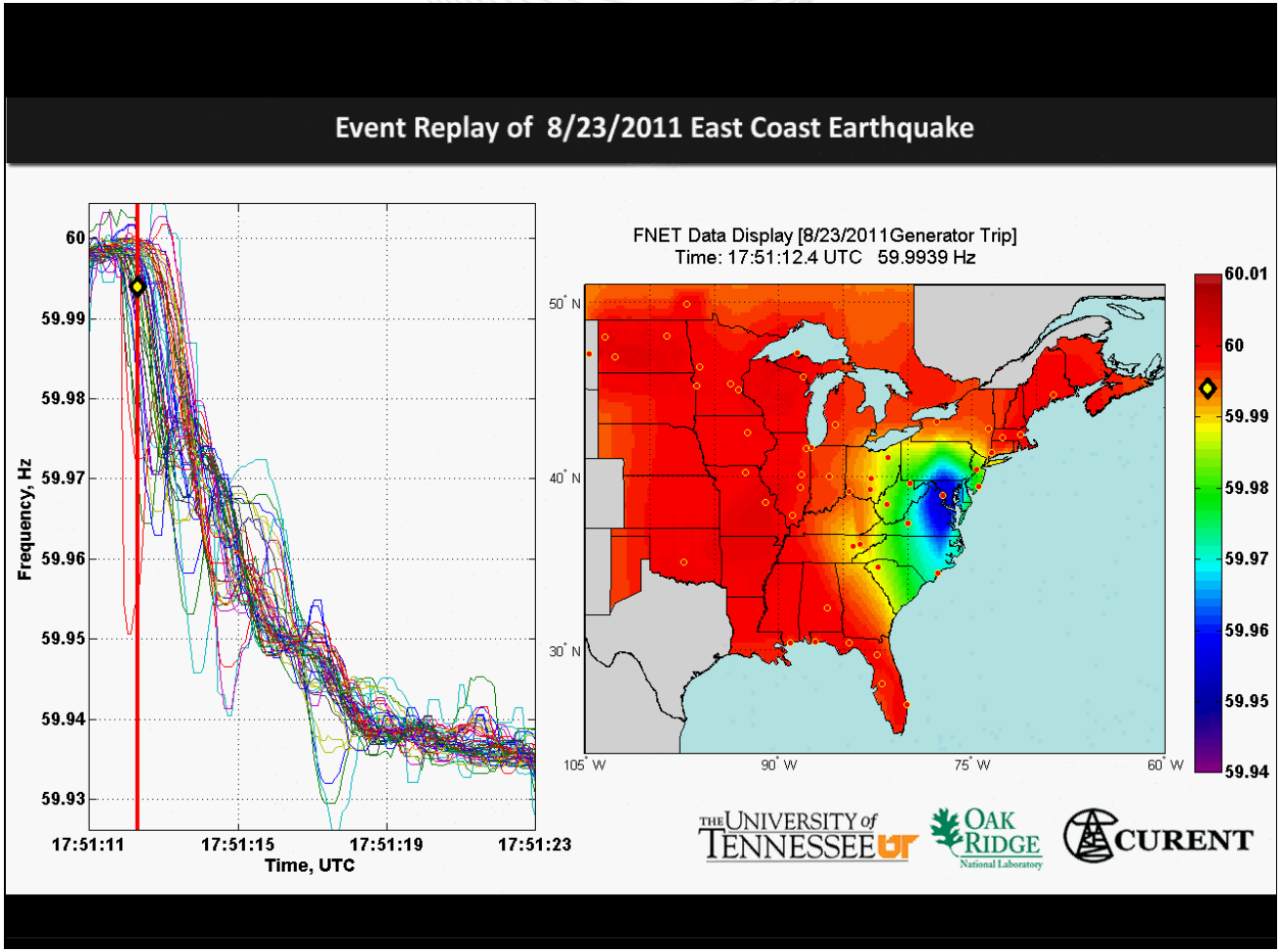
From UT Current F-net

August 23, 2011 Earthquake Near Richmond VA



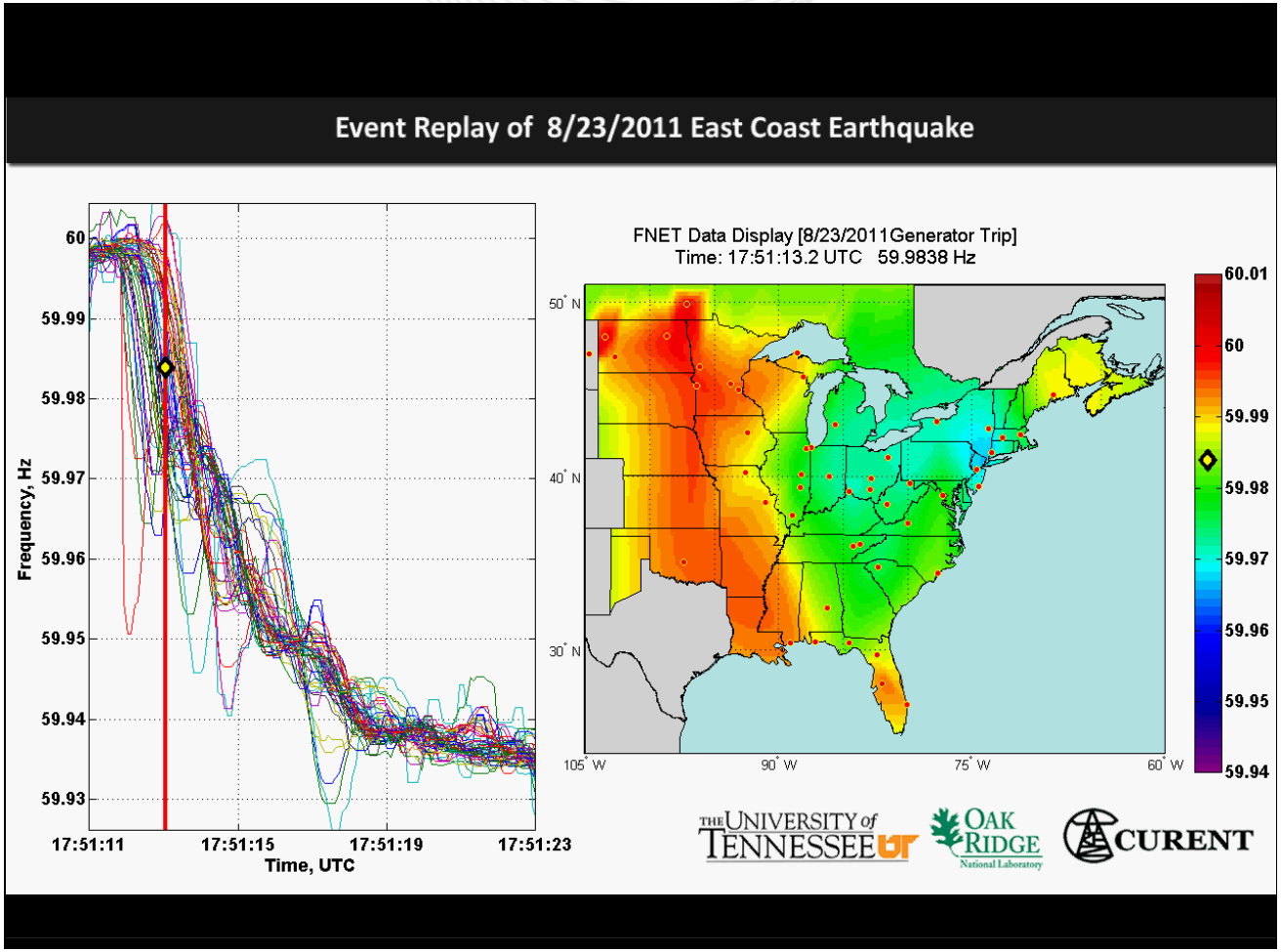
From UT Current F-net

August 23, 2011 Earthquake Near Richmond VA



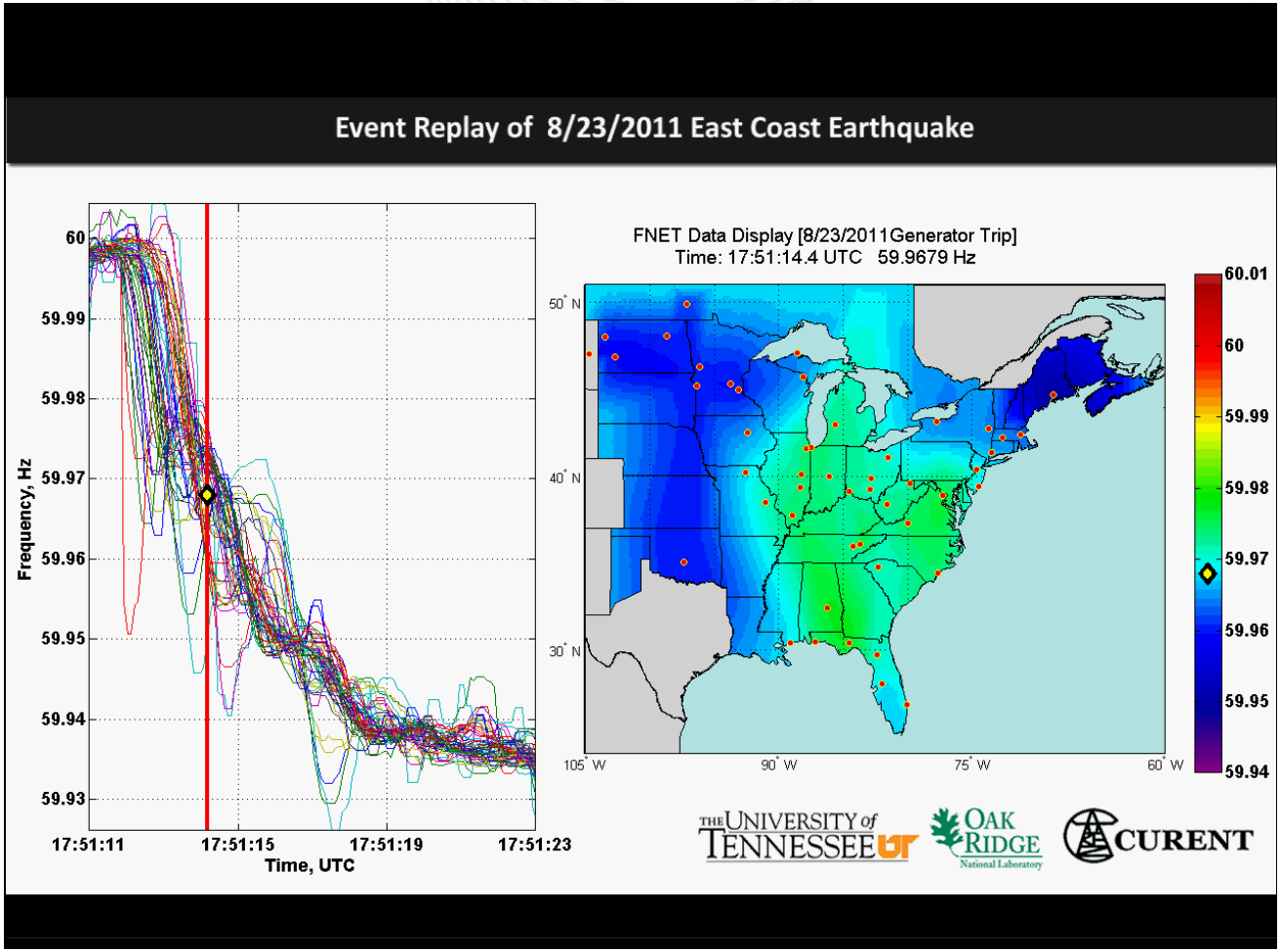
From UT Current F-net

August 23, 2011 Earthquake Near Richmond VA



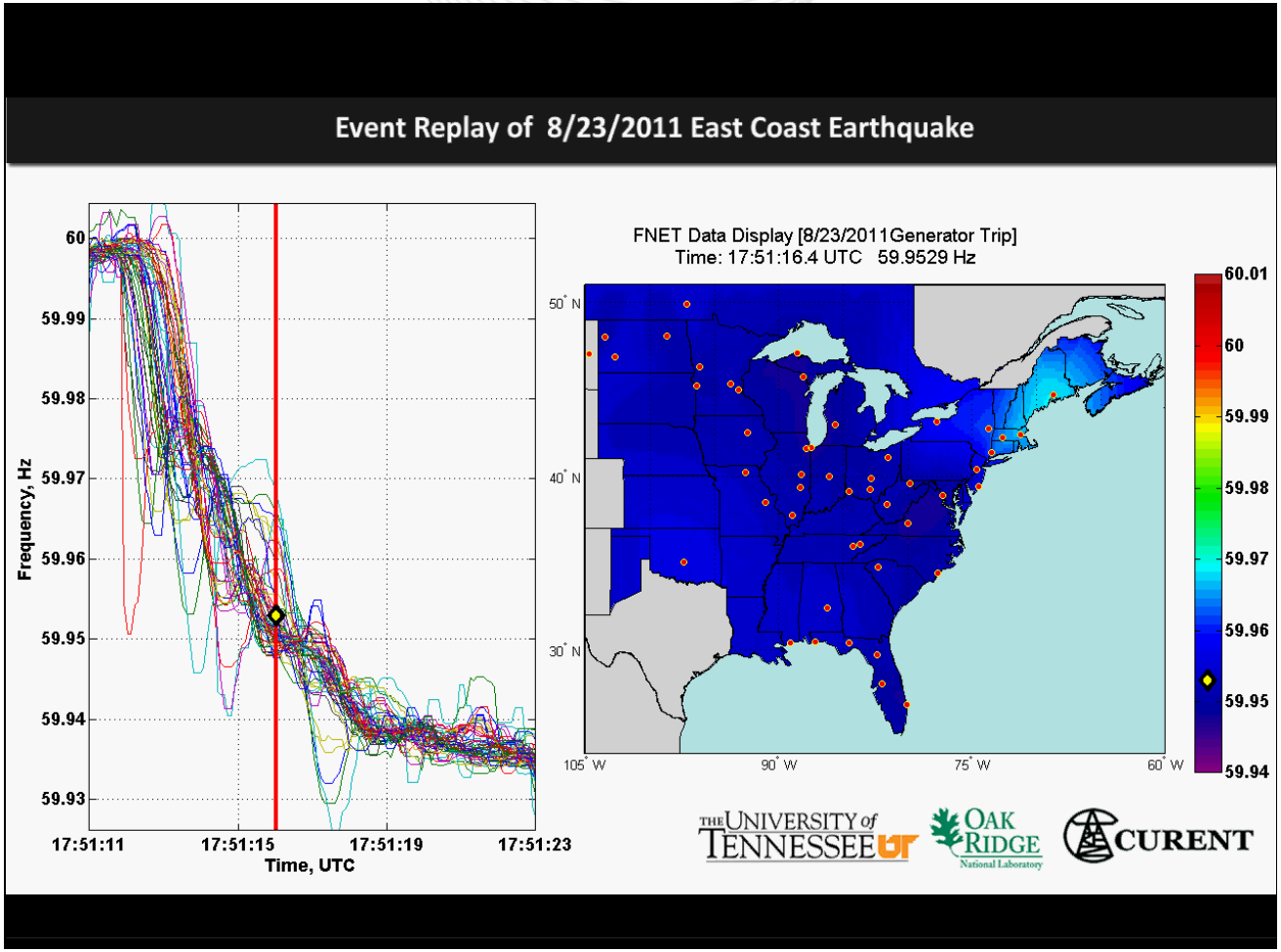
From UT Current F-net

August 23, 2011 Earthquake Near Richmond VA



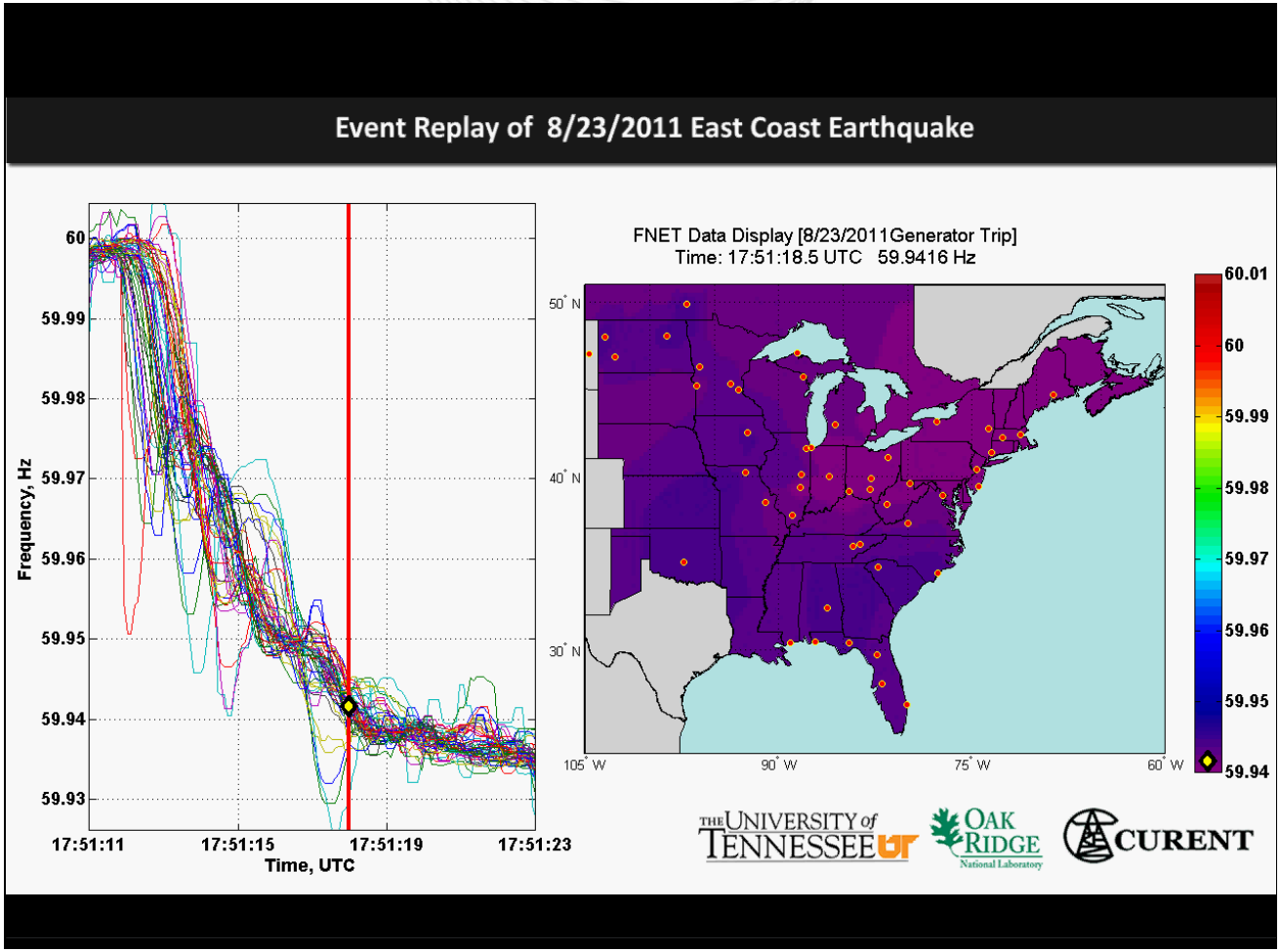
From UT Current F-net

August 23, 2011 Earthquake Near Richmond VA



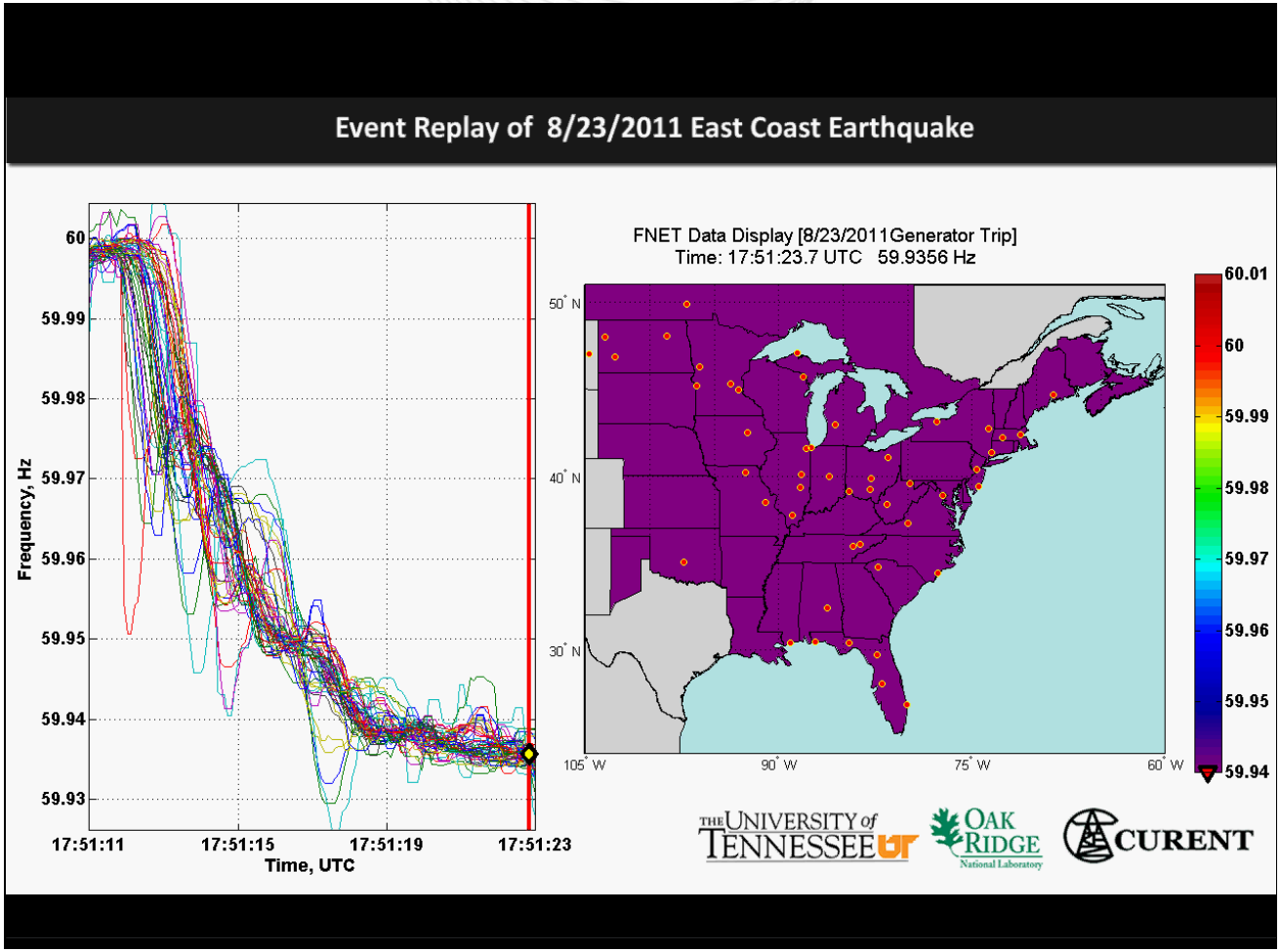
From UT Current F-net

August 23, 2011 Earthquake Near Richmond VA



From UT Current F-net

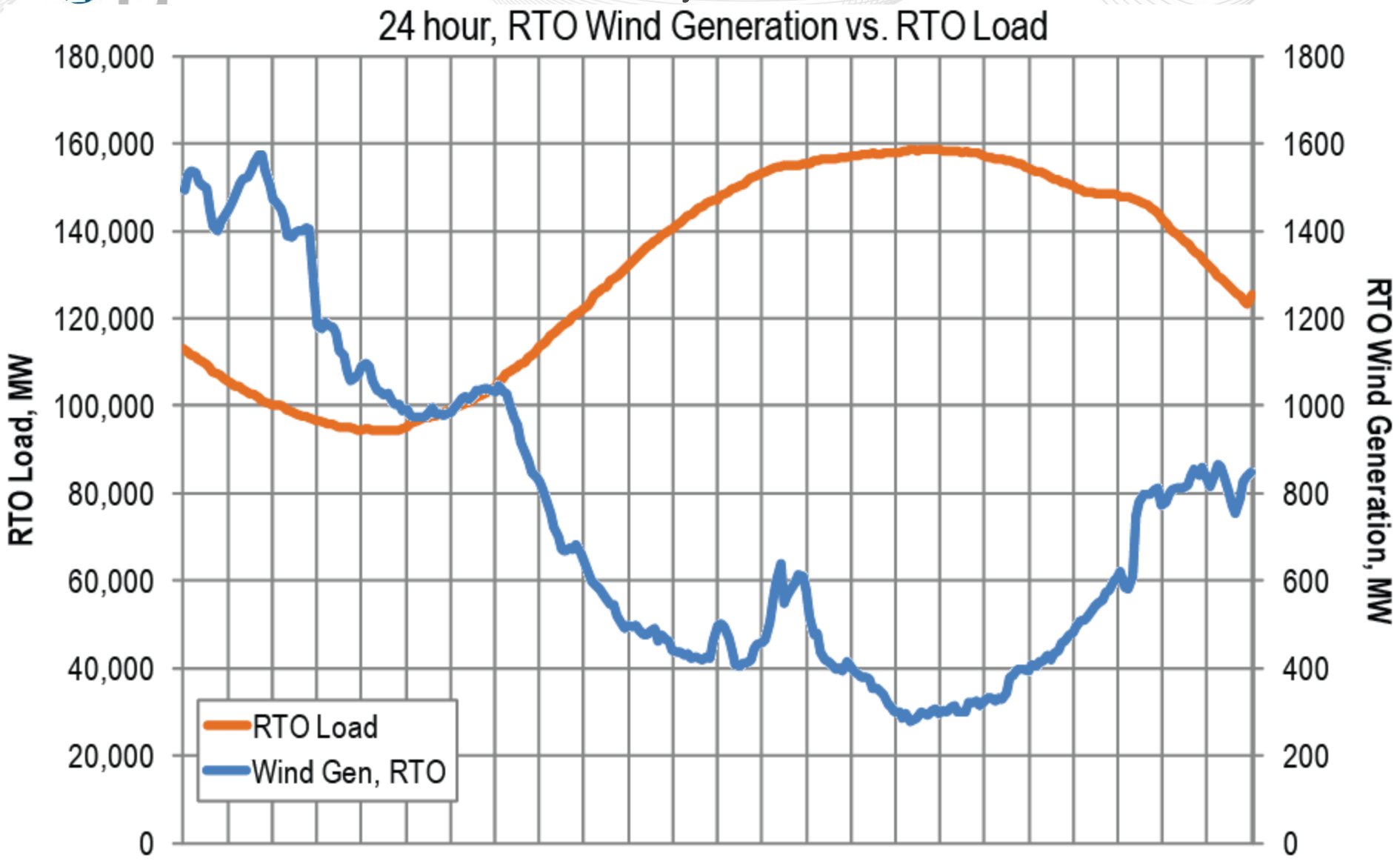
August 23, 2011 Earthquake Near Richmond VA



From UT Current F-net

Summer 2011---How Hot Was It?

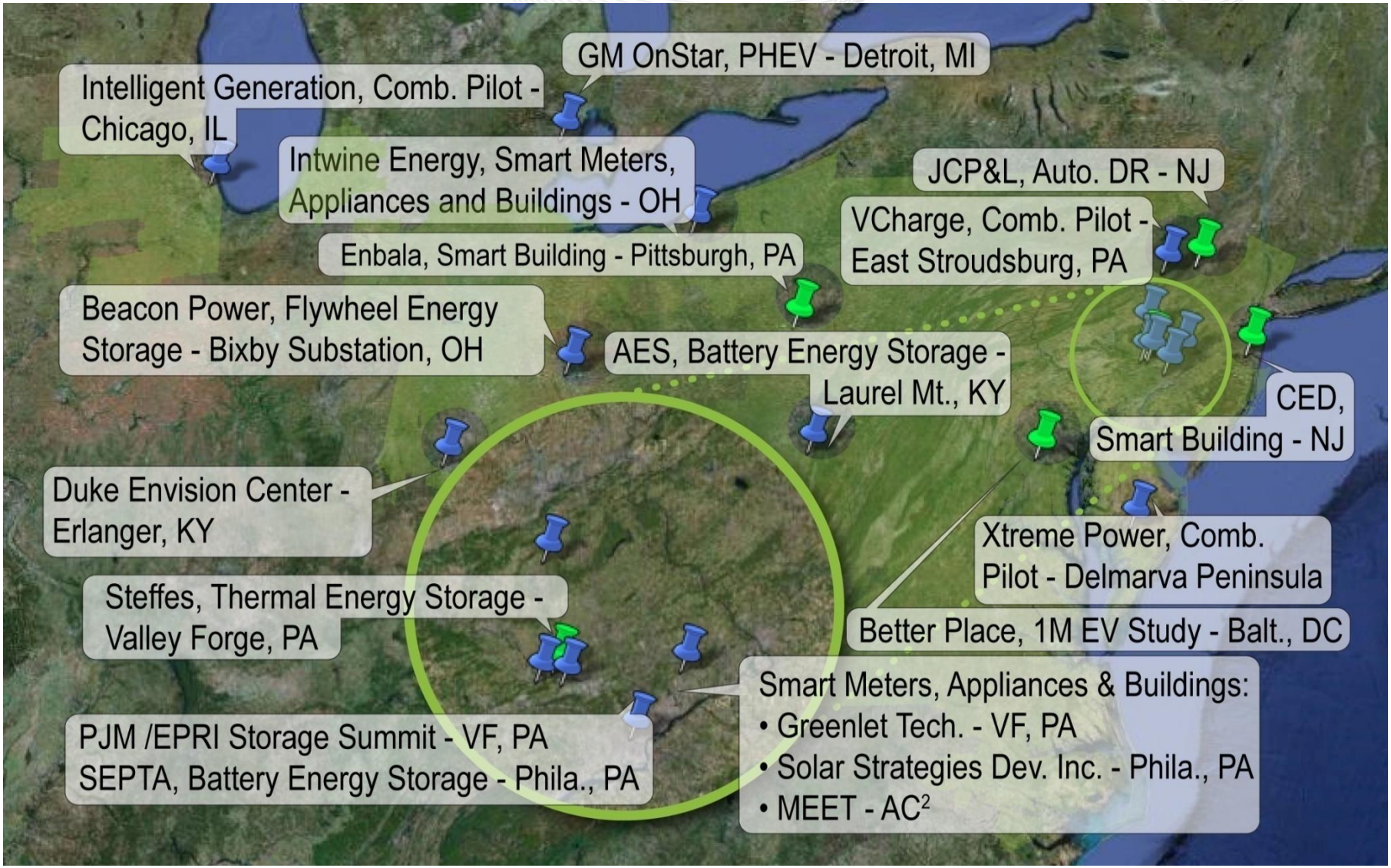
July 21, 2011 – PJM New All-Time Peak



The only sustainable competitive advantage is the ability to learn *faster* than the competition.

Partnering for load frequency control with loads and storage.

PJM ATRP Program

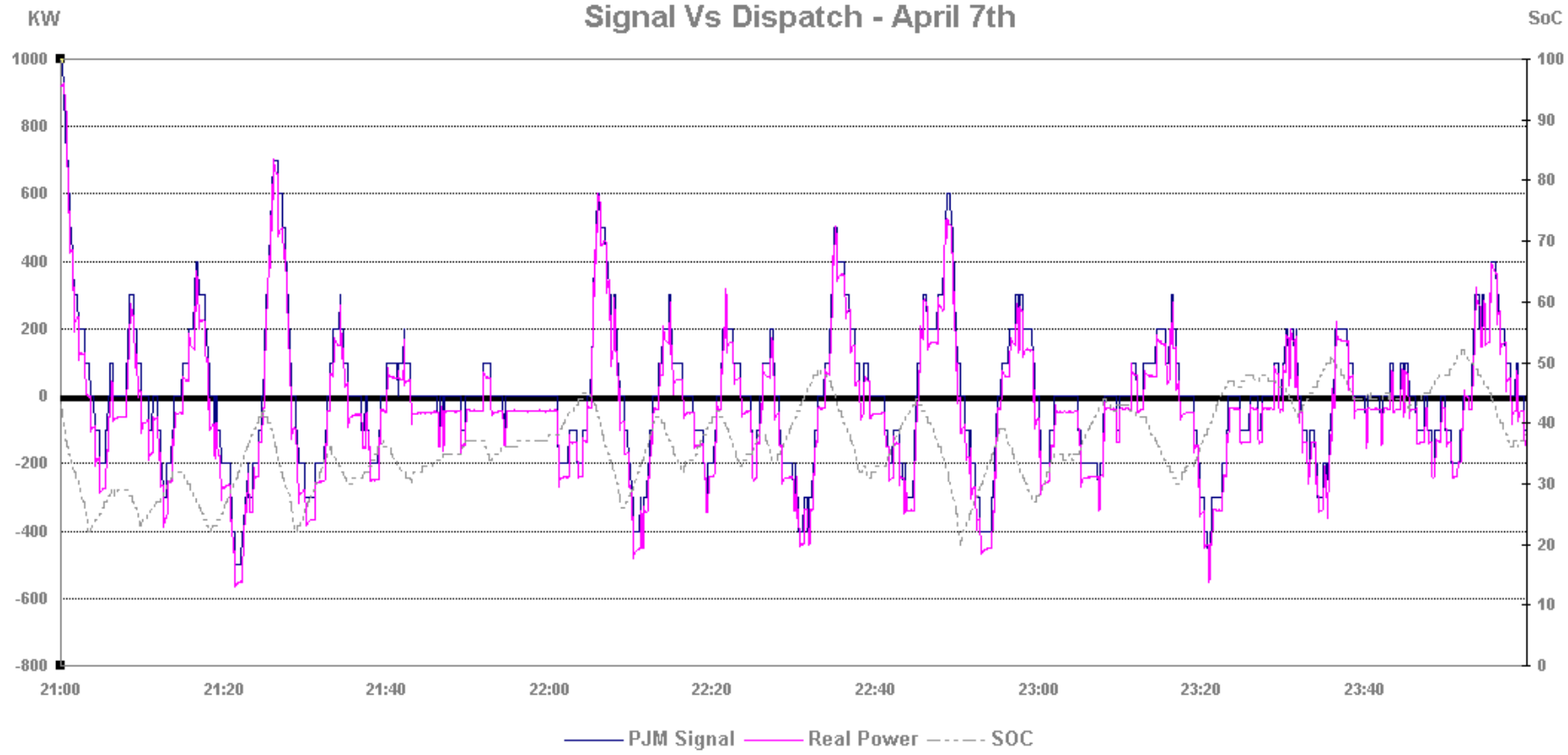


Grid-Scale Energy Storage System – 1 MW Battery

Operational Details

- Lithium-ion nano titanate (Altairnano)
- Power 1 MW, Energy 250 kWh
- Full capacity duration, 15 minutes
- Efficiency, 90% round trip (AC-AC)
- Usable Charge Range, 5%-99%
- 2 years, 280,000 cycles, < 2% degradation

Operational Performance:

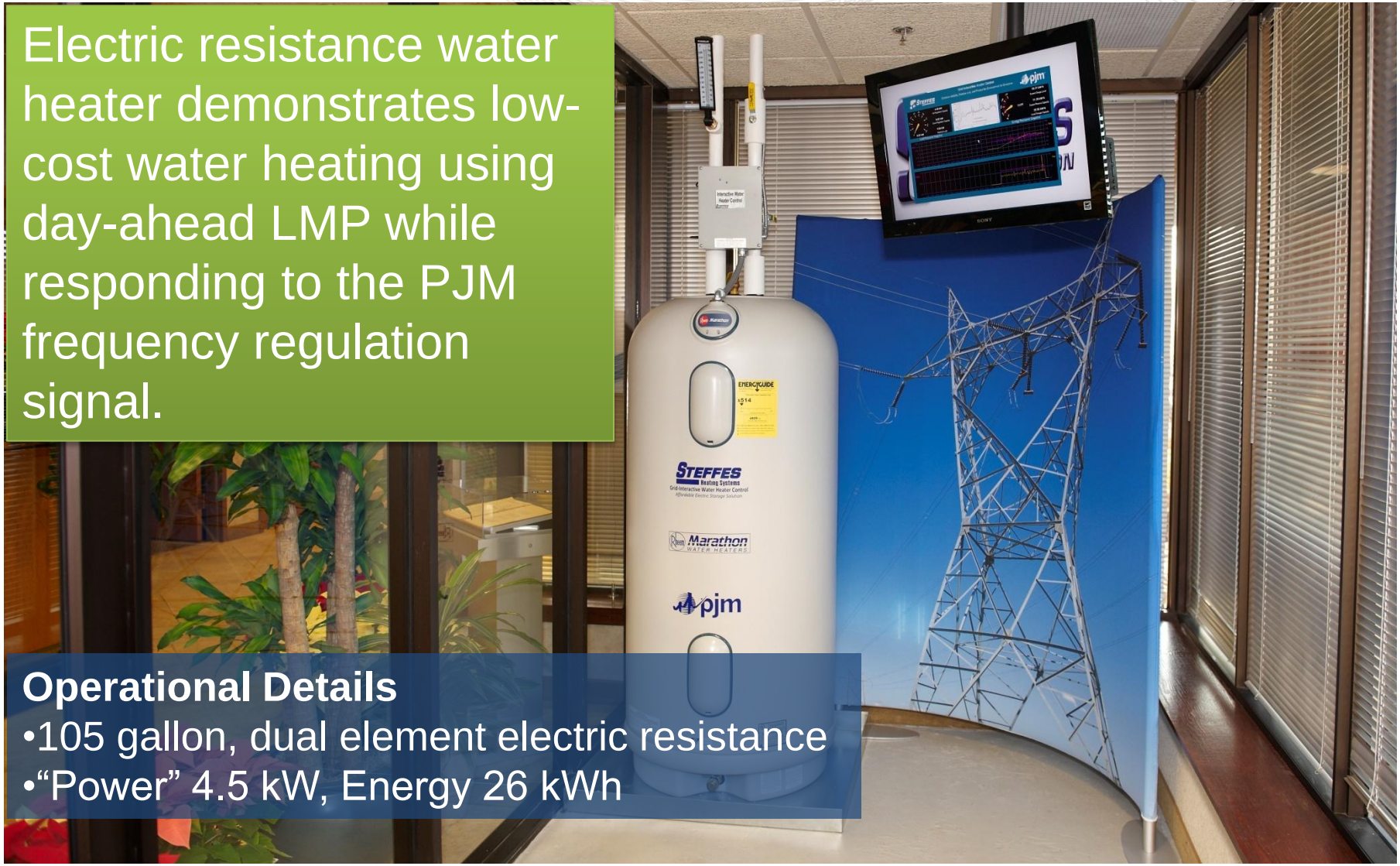


Will Work for Fuel…

Available for a full time summer job.

Electric Thermal Storage: Water Heaters

Electric resistance water heater demonstrates low-cost water heating using day-ahead LMP while responding to the PJM frequency regulation signal.

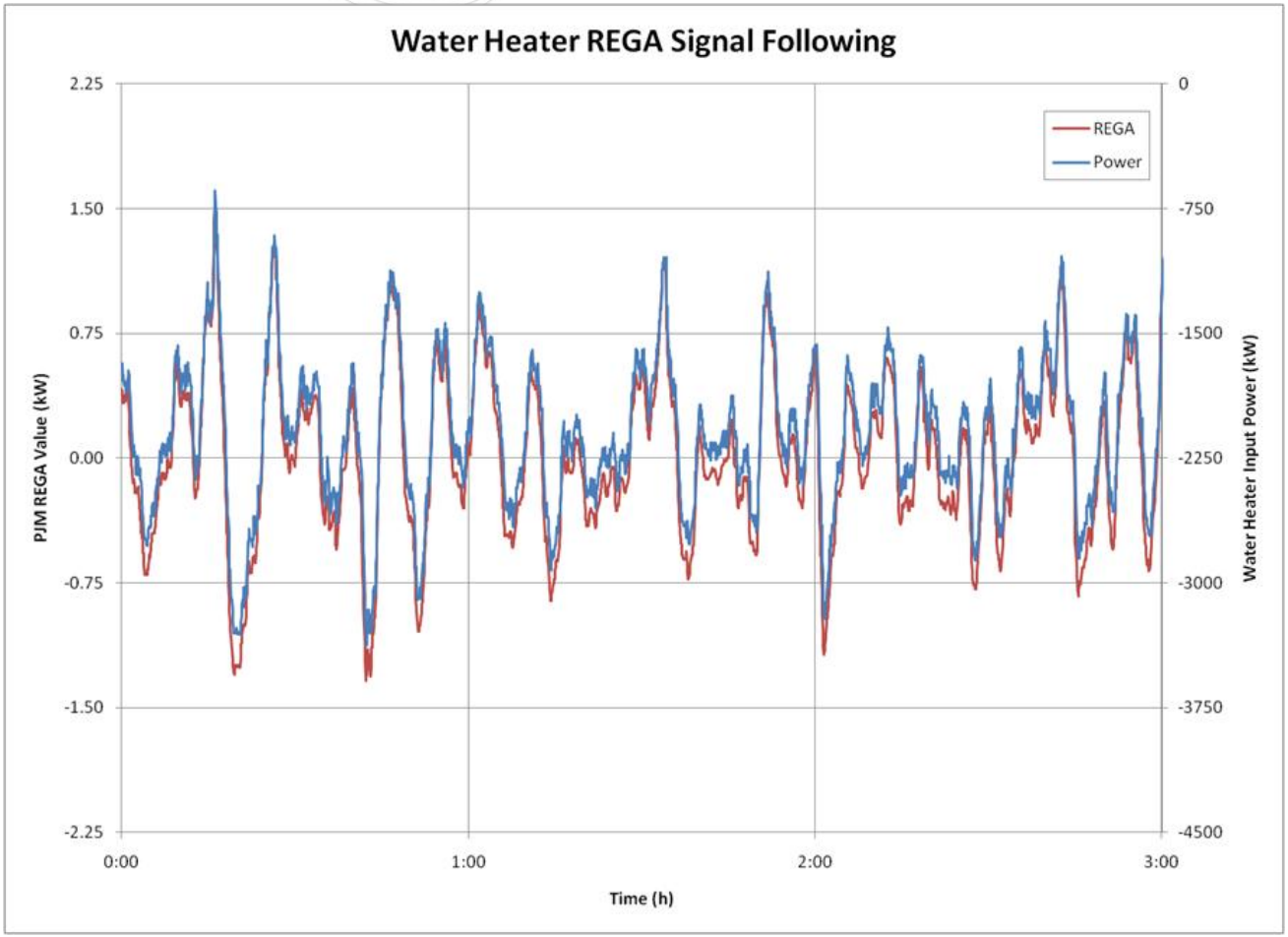


Operational Details

- 105 gallon, dual element electric resistance
- "Power" 4.5 kW, Energy 26 kWh

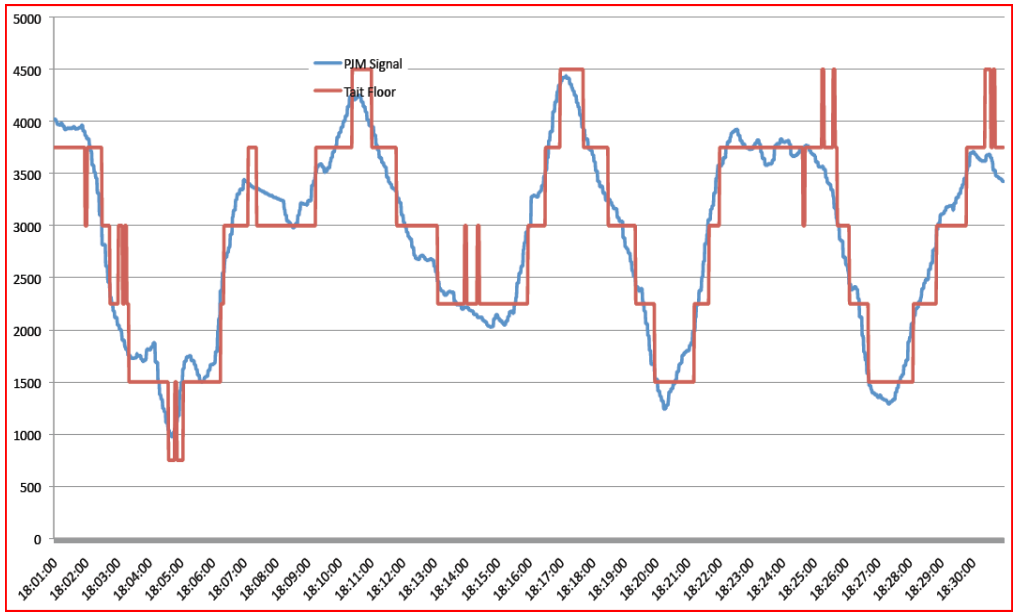
PJM pilot water heater -- January 14, 2011; Midnight to 3:00 a.m.

- PJM Frequency Regulation Signal
- Water heater power consumption +/- 2.25 Kw base point



Electric Thermal Storage: Space Heaters

- Vcharge Inc. controlling ETS units in 30 homes
  - Stroudsburg, PA
- Could save each household 6 – 9 cents/kWh if controlled for energy purchasing and Regulation
- 14,000 units deployed in PPL in 1980's



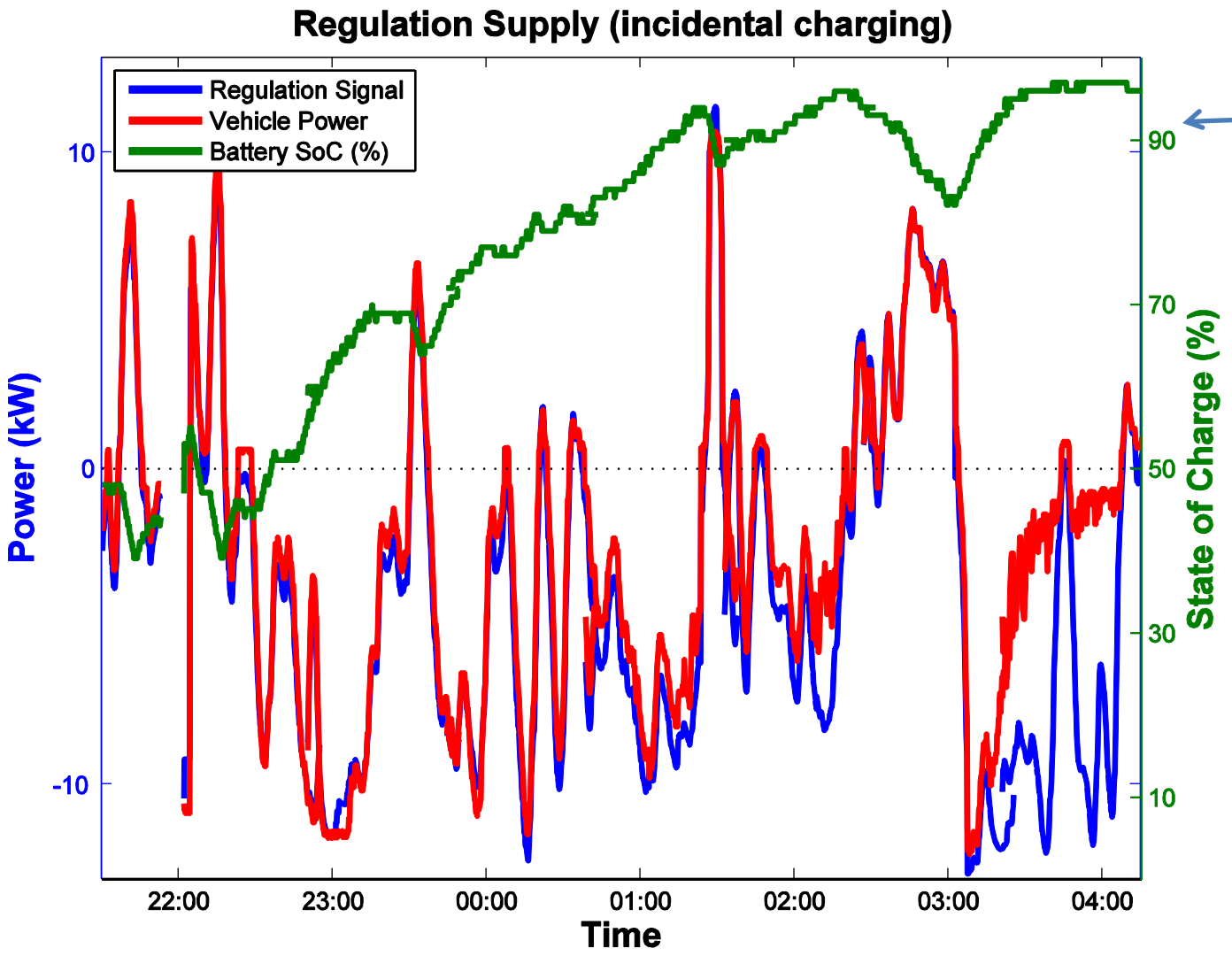
Distributed Mobile Storage – EV Batteries

Mid-Atlantic Grid Interactive Car Consortium Vehicle-to-Grid Demonstration

- Each vehicle capable of 19.2 kW. Actual average capacity ~12 kW
- First demonstrated October 2007
- Currently aggregating five vehicles in Delaware

Operational Details
- Lithium-ion, 18650 cells ("laptop batteries")
- Power 19.2 kW, Energy 35 kWh
- Full capacity duration, 1.8 hours
- Efficiency, 80-85% round trip (AC-AC)
- Usable Charge Range, 5%-99%

Operational Performance:



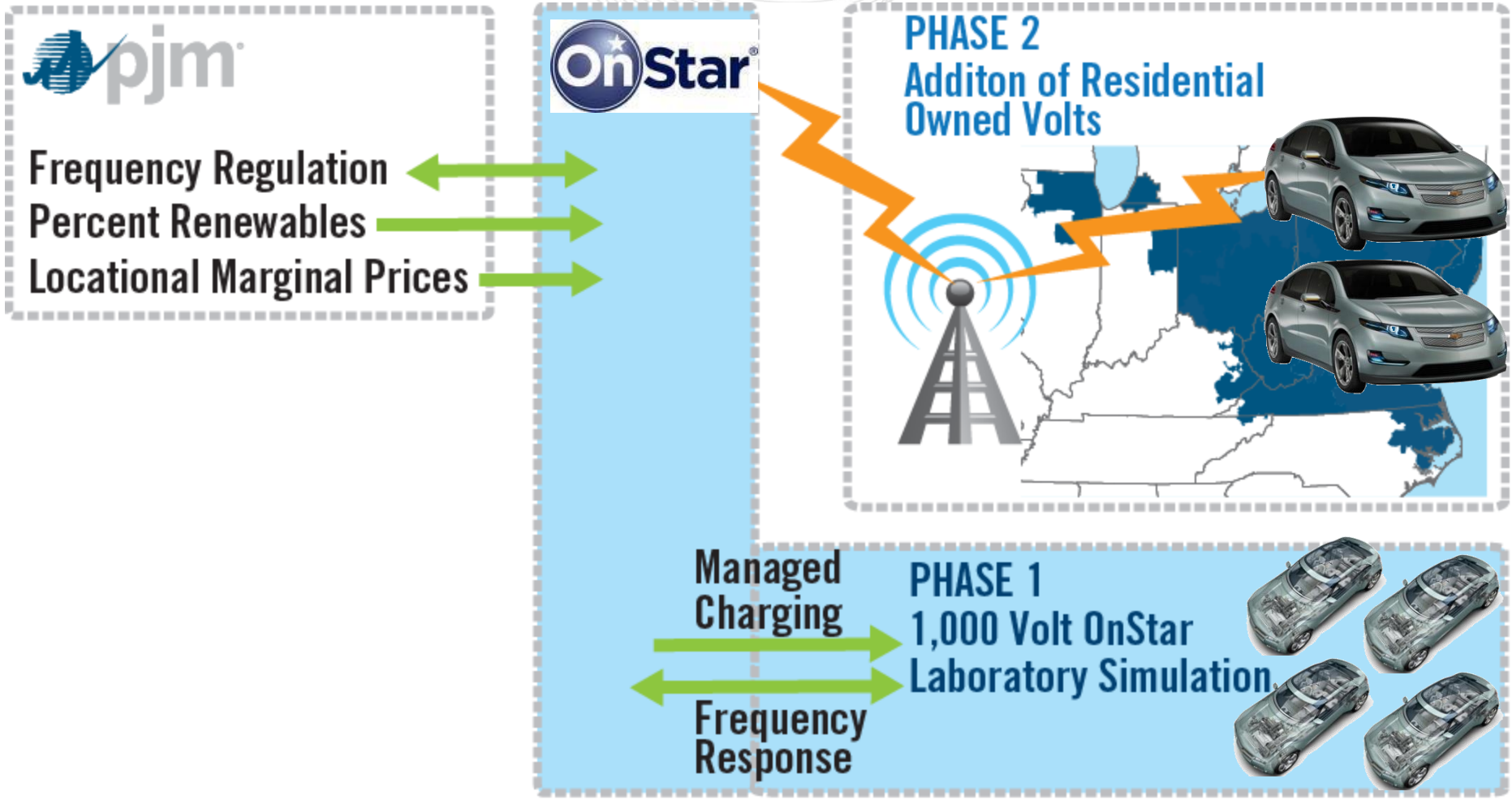
More Reg down during these hours means increasing state of charge

Pony Under the Christmas Tree?

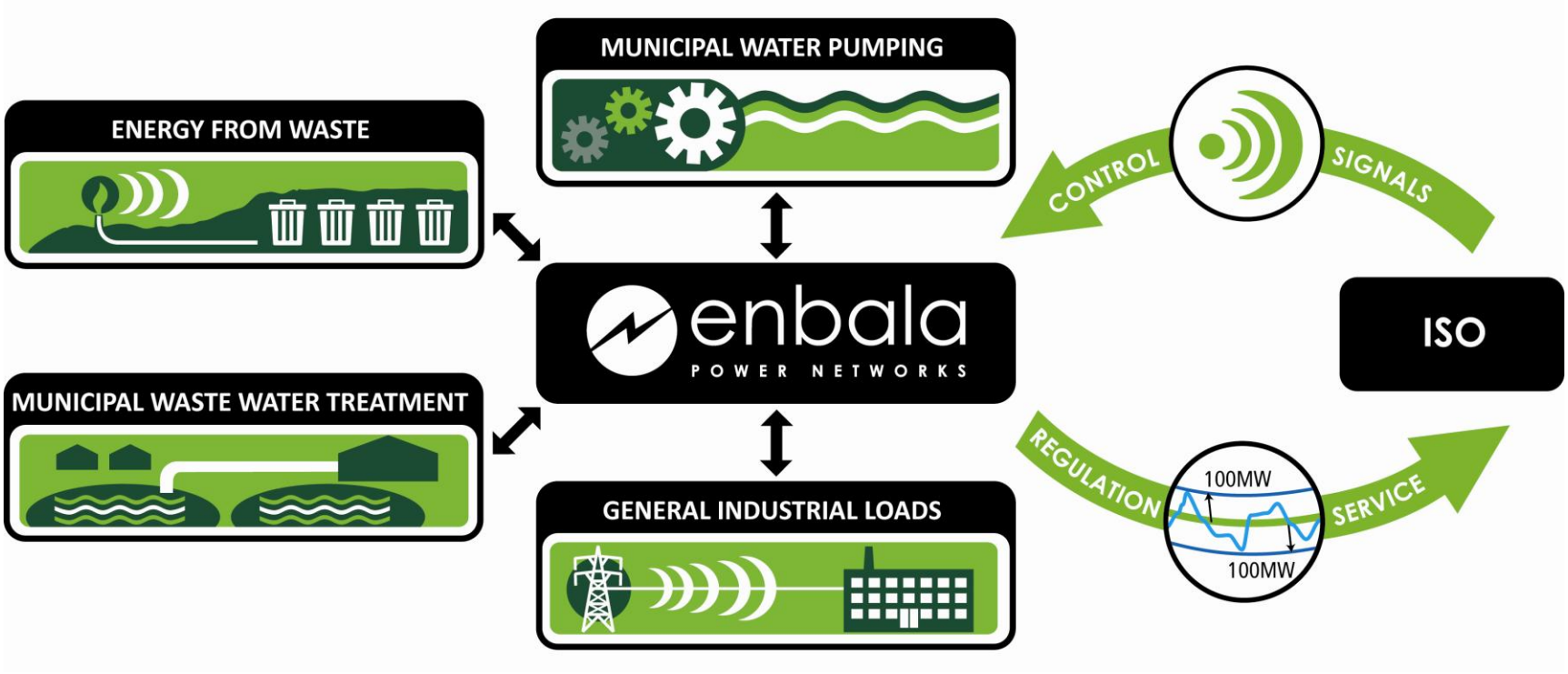
60¢ (PJM Off-peak Price)

~~75¢~~ per "Gallon"

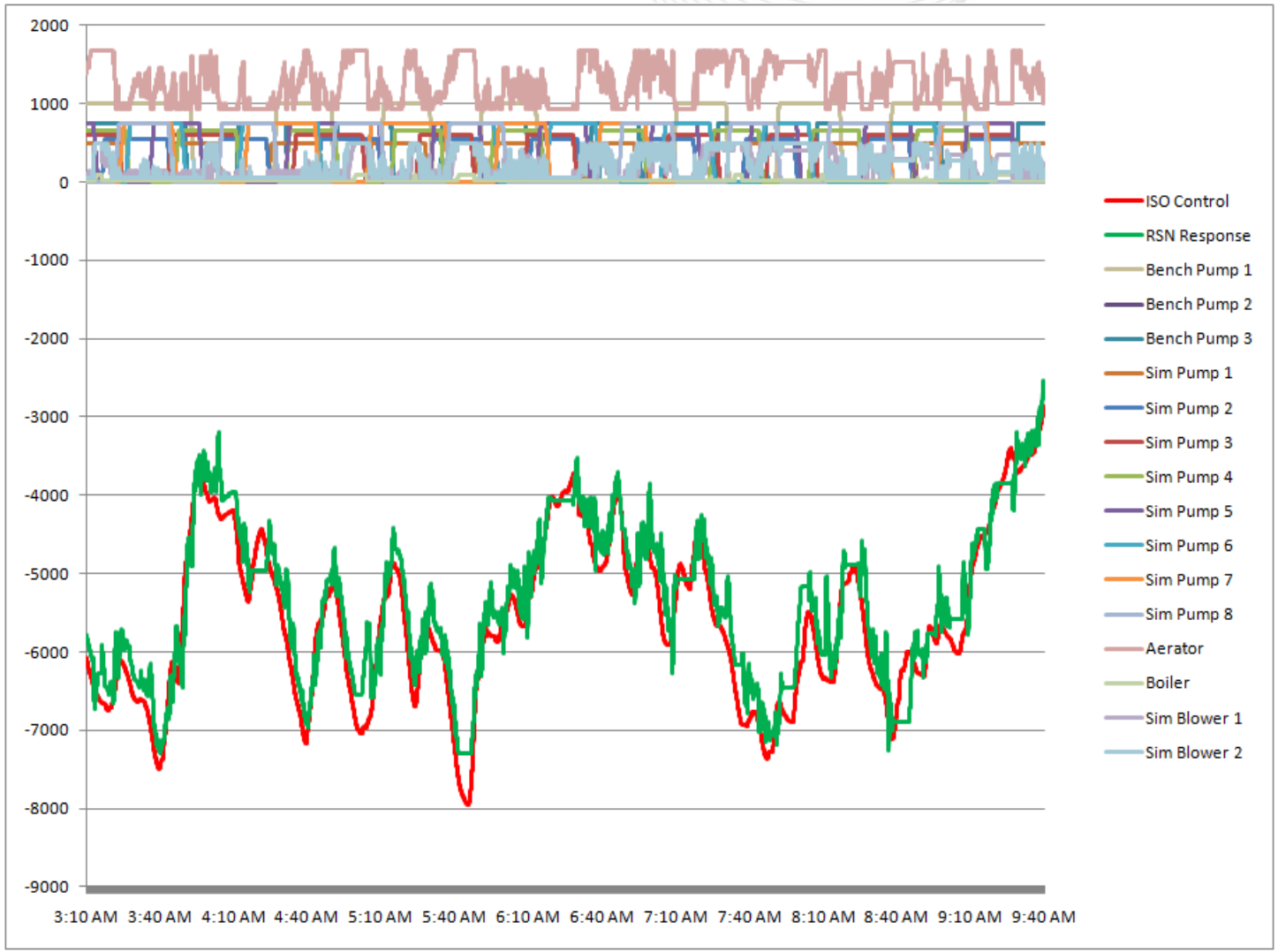
General Motors, OnStar: Large-scale aggregation



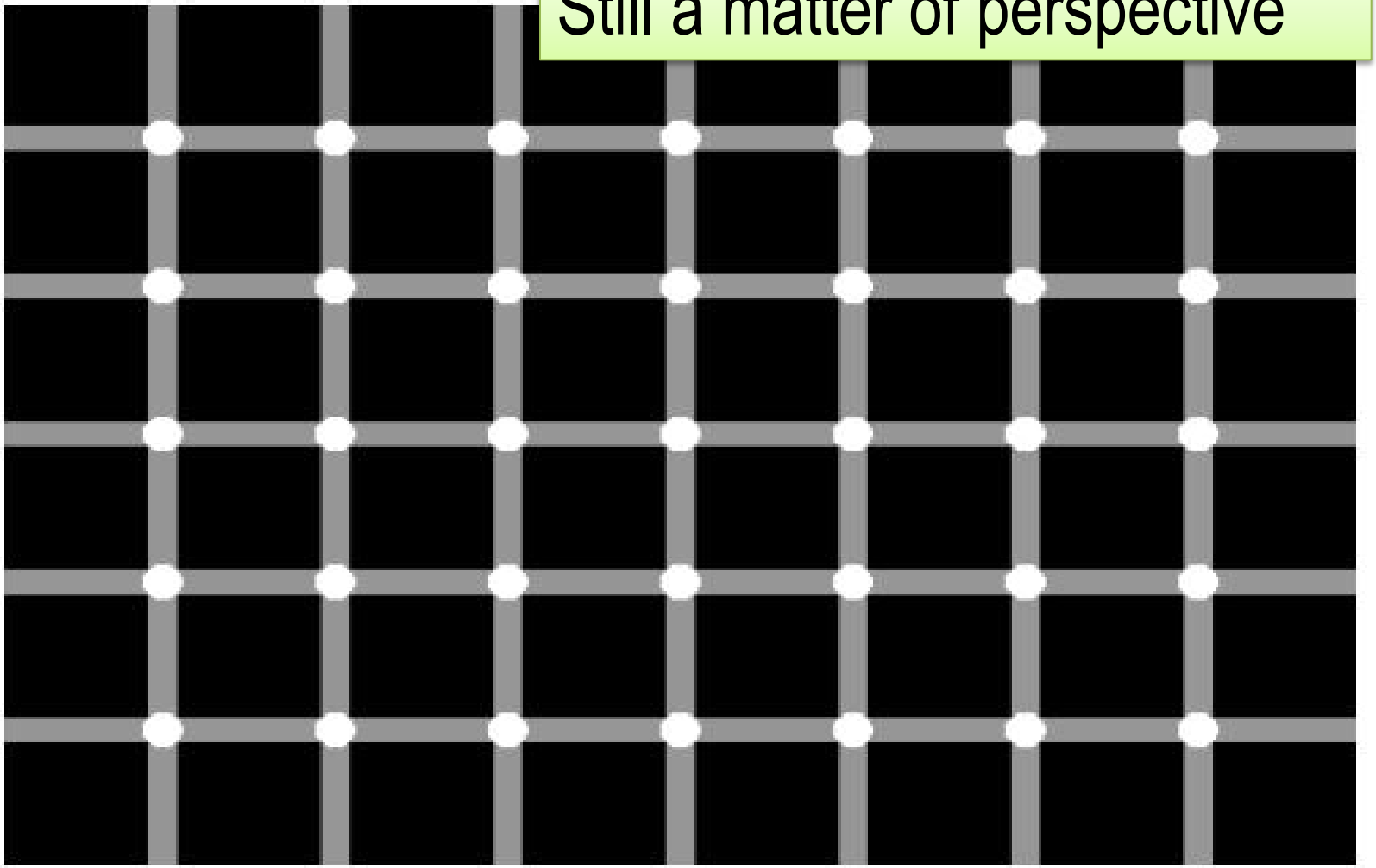
ENBALA's Power Network (EPN)



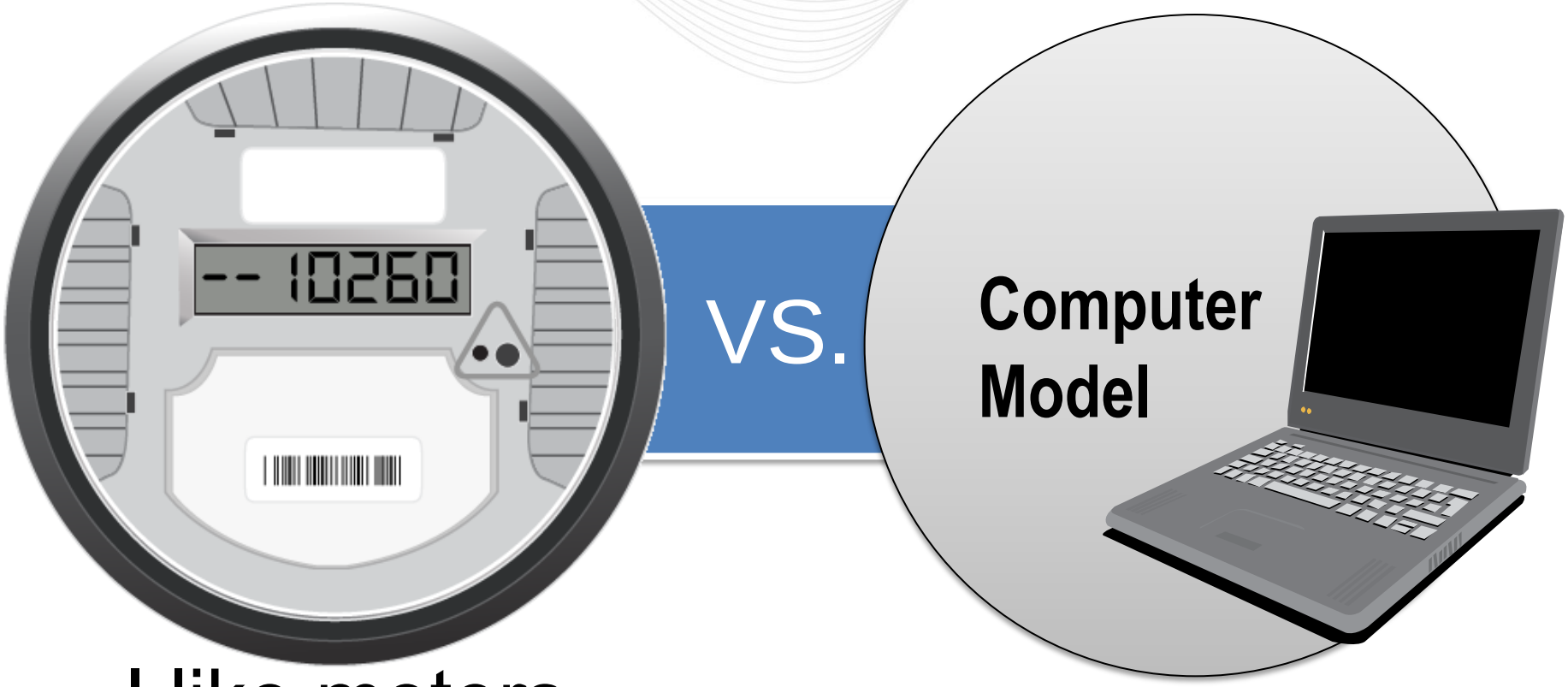
Operational Performance – Aggregation of 16 water pumps:



Still a matter of perspective



How many black dots?



I like meters…

…but they cannot meter “Negawatts”

Union Station – 1908