

# ***Markets, Regulation and Energy Storage: A Match Made in Heaven?***

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**“We’re Mad as Hell  
and We’re Not Going  
to Take It Anymore!”**



## *At the Wholesale Level...*

- Transmission access
  - Negotiation of “wheeling rights”
  - Discriminatory treatment
  - Lengthy litigation: *“Refunds to a Corpse”*
- Build-out costs
- “Reliability” and “native load” as code
- *TLRs, demand ratchets, price squeeze you name it...*

## *At the Retail Level---*

- Rates significantly above the national average
- Industrial subsidies for public interest programs
- Investment stagnation
- Hit to global competitiveness

- Reminding the Regulator What We Got Right: *Taking credit for our accomplishments*
- Building on Past Experience: *Learning What Needs Further Work*
- Avoiding the Quagmire of Inaction

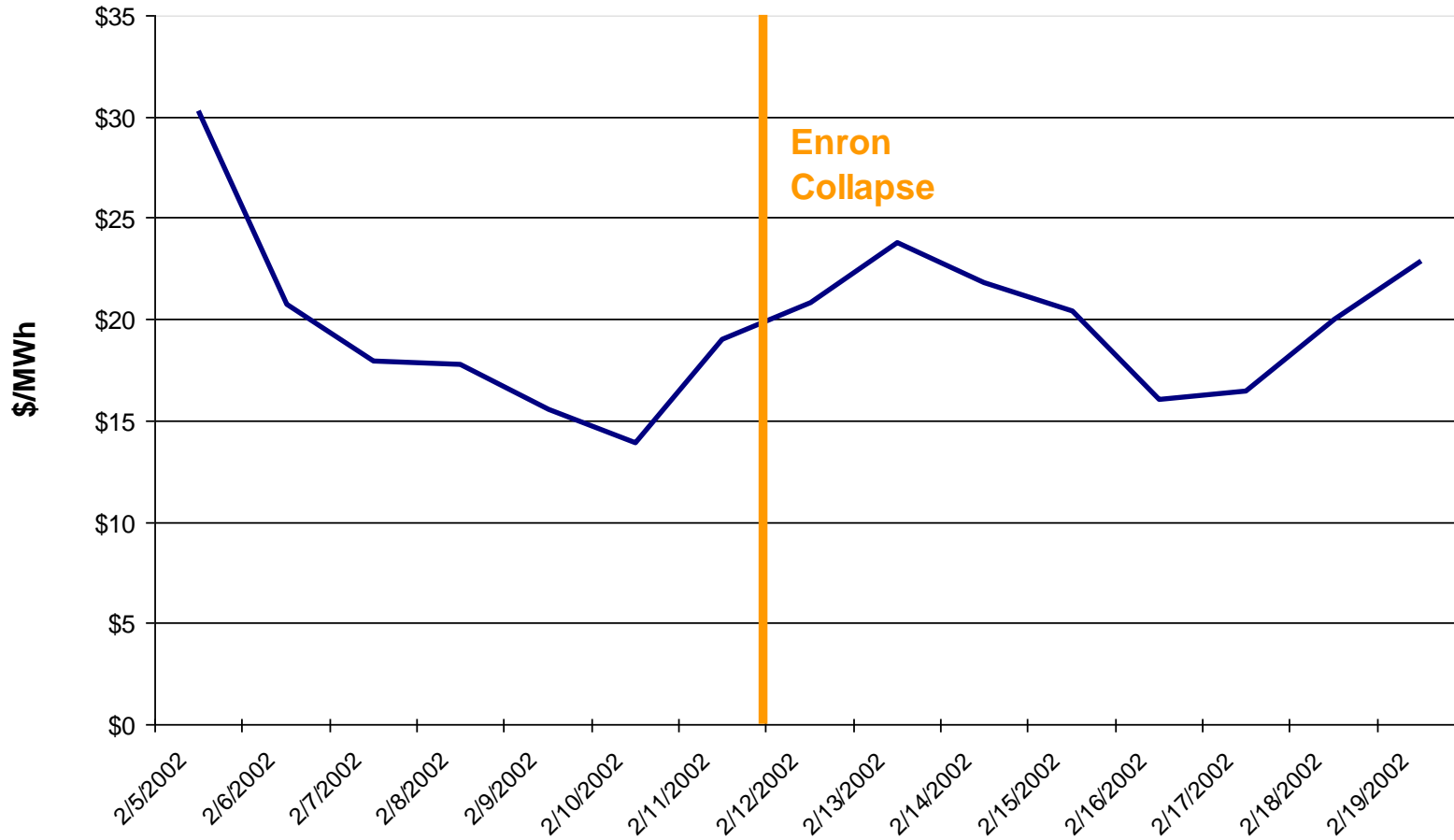
## Report Card

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## **Accomplishment No. 1:**

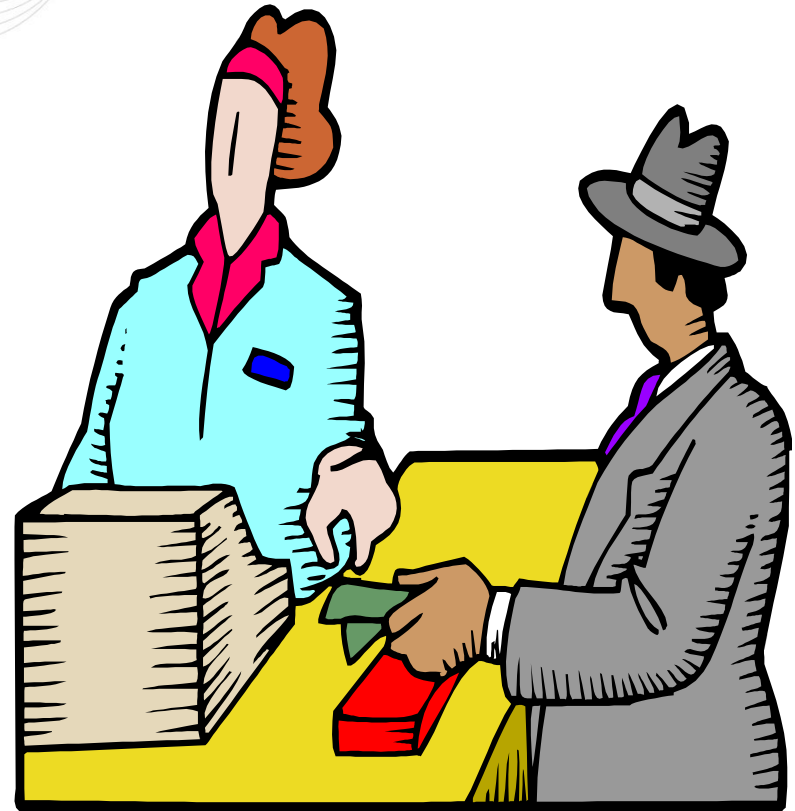
We moved the risk allocation formula:  
*aka “There was no Enron rate case!”*

## Mean PJM RTO LMP





- Consumers are paying for higher commodity costs not “bail-outs”
- If anything, capacity prices too low
- Markets delivering signals: We need to react to them wisely

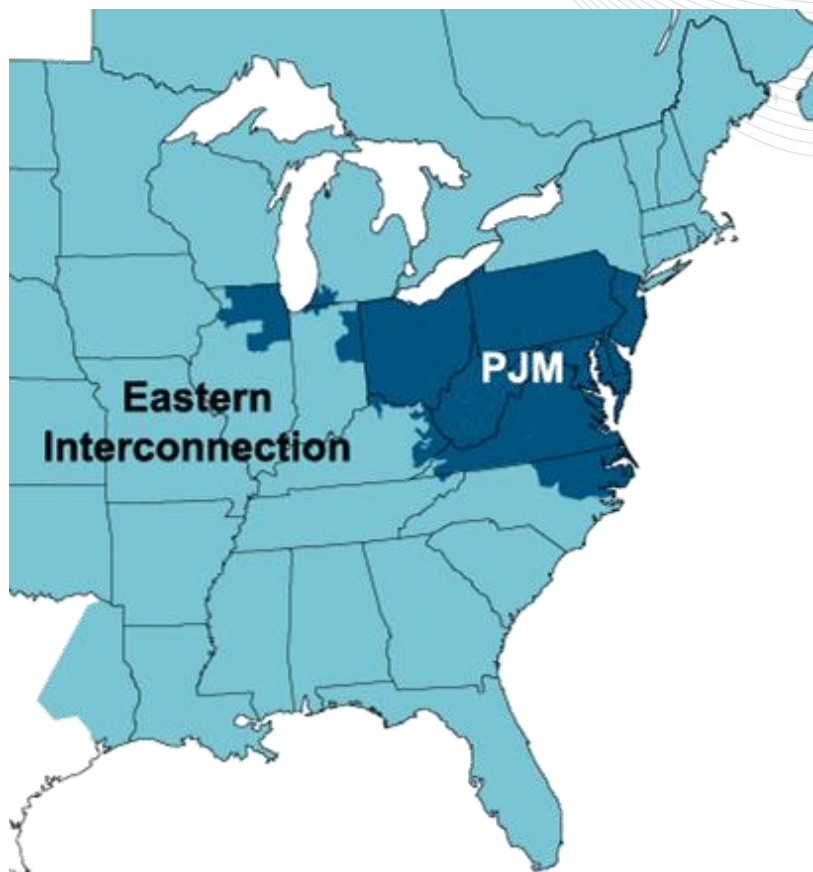


## **Accomplishment No. 2:**

We got the fundamentals right!



- Structural Solutions Have Worked
  - Eliminating multiple control areas
  - Regional planning
  - Redispatch in lieu of TLRs
  - Maximizing use of the Grid
  - Allowing customers to make economic decisions
  - Transparency

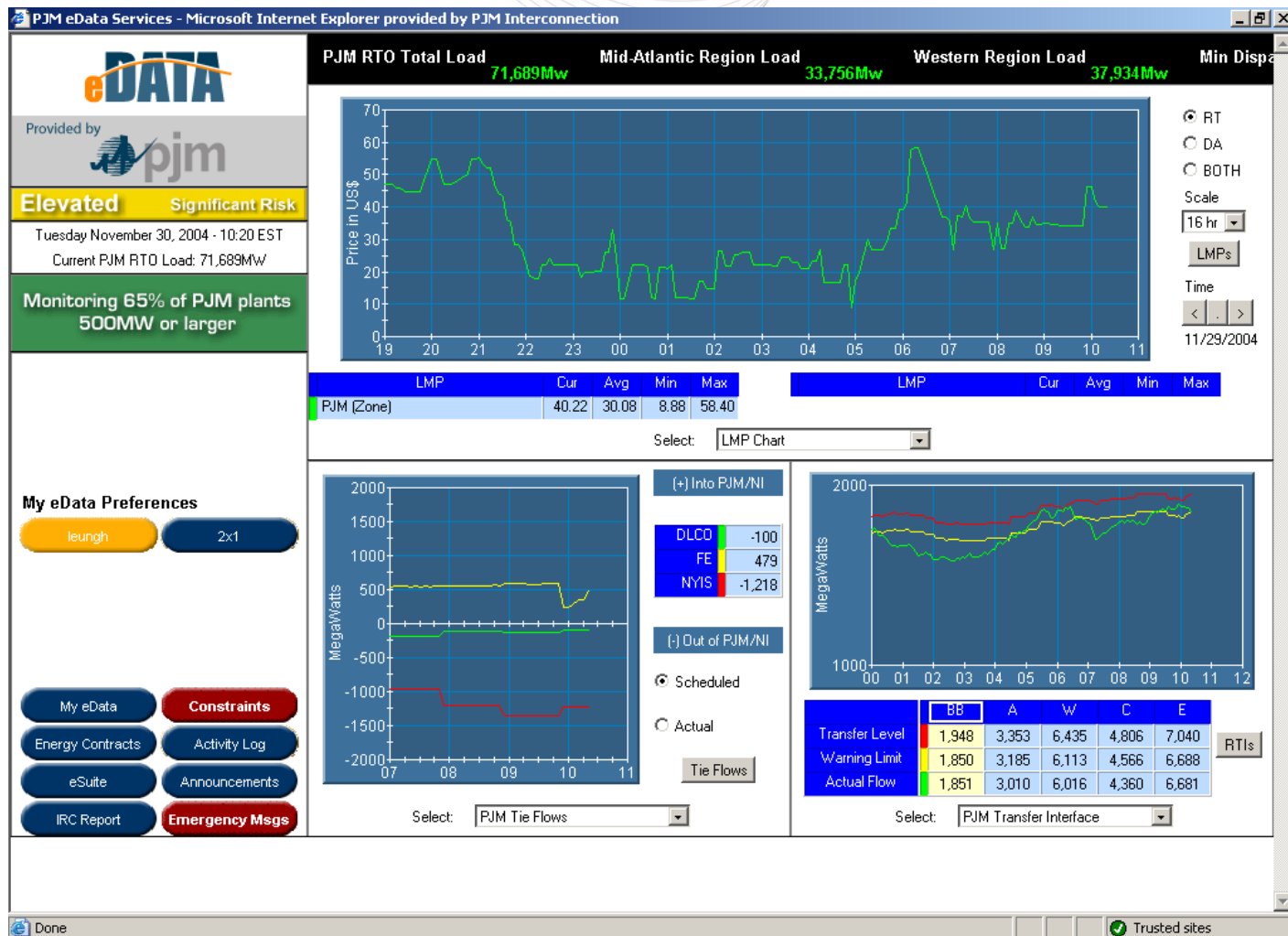


**21% of U.S. GDP  
produced in PJM**

## KEY STATISTICS

Member companies	800+
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
States served	13 + DC

As of 7/2012

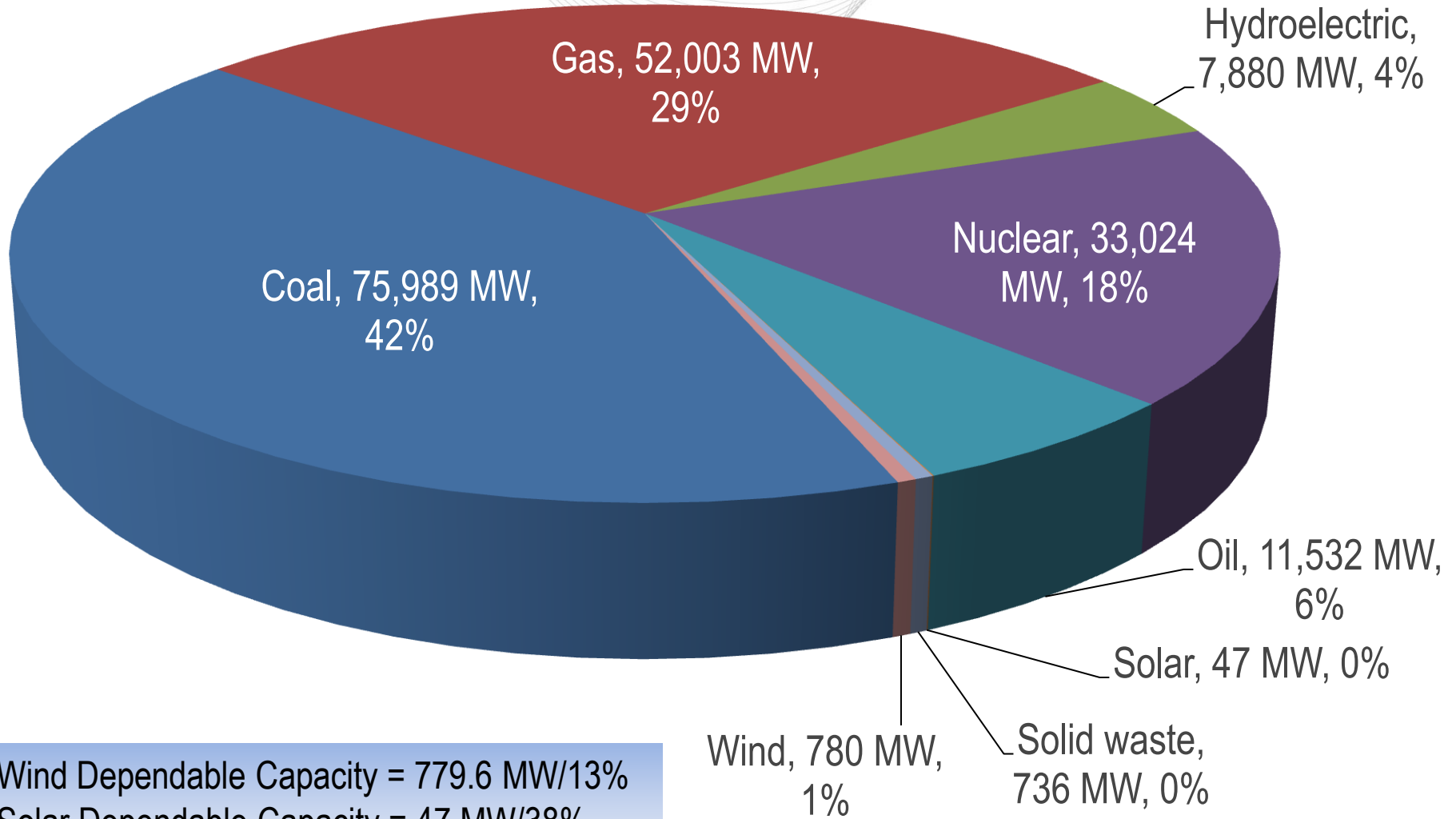


Energy Storage: *Now, more than ever...*

The rapid “change-out” of the fleet...



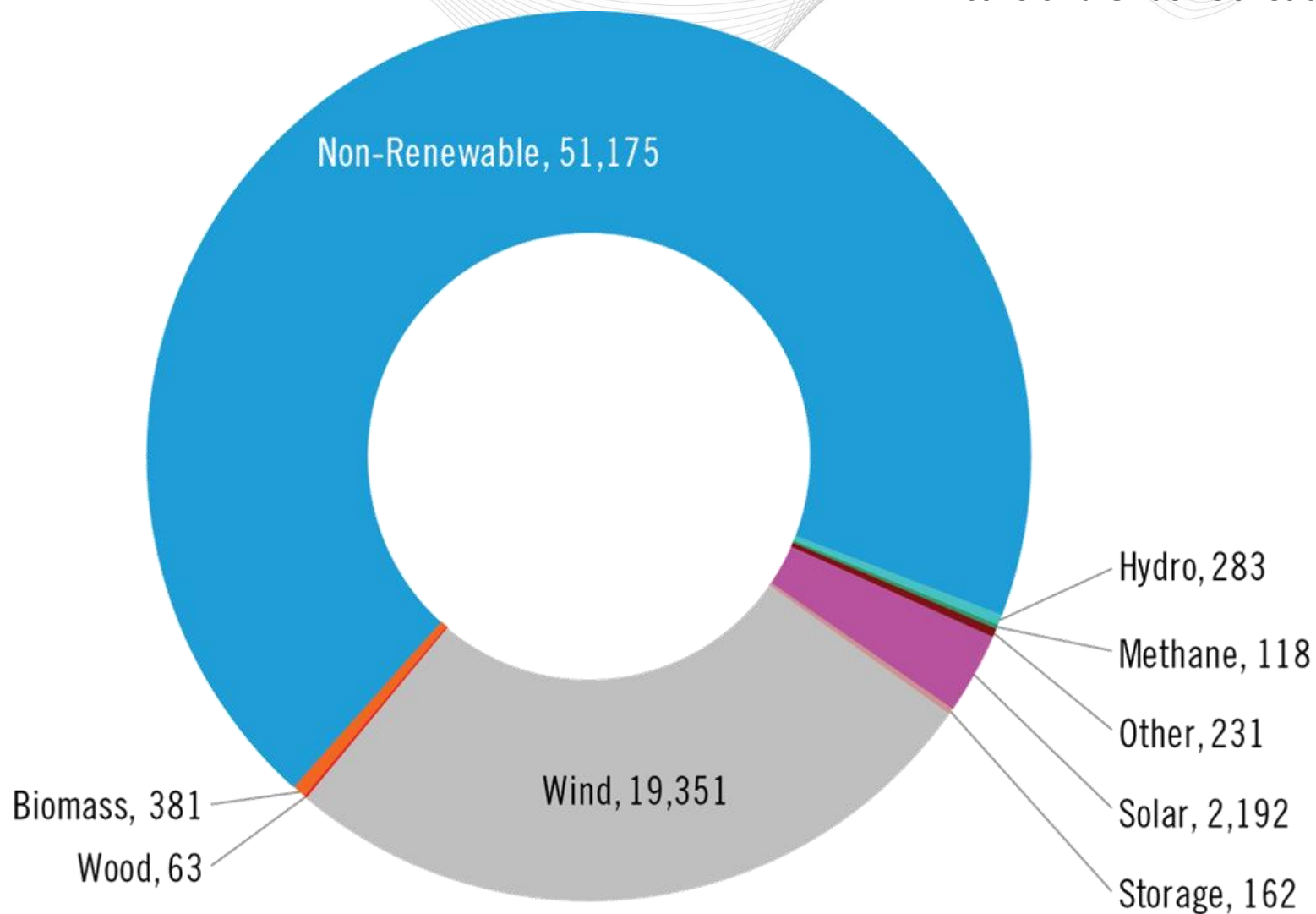




As of 12/31/2012

# PJM Queued Generation (Nameplate Energy) MWE

Active and Under Construction

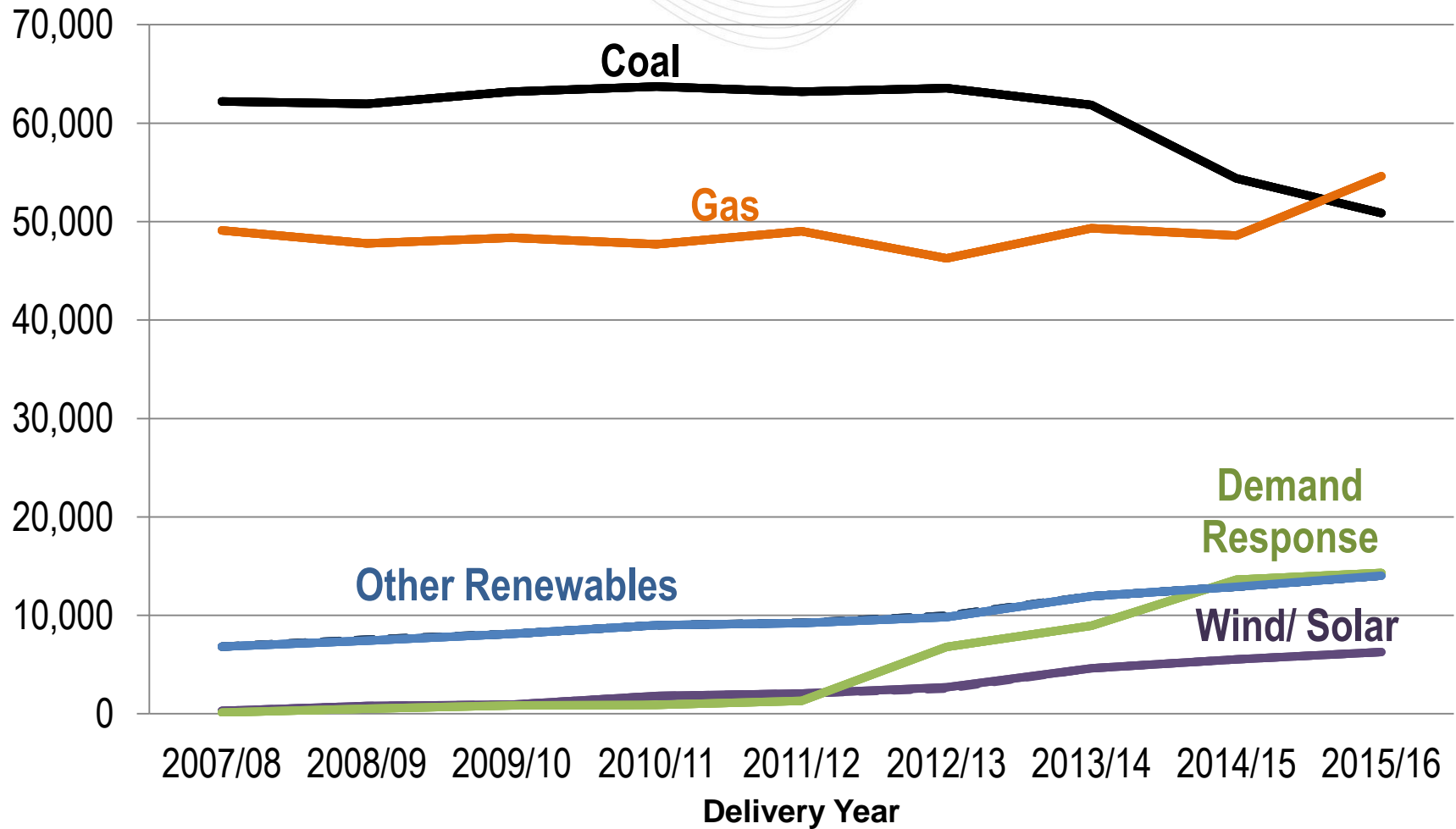


As of 03/2013

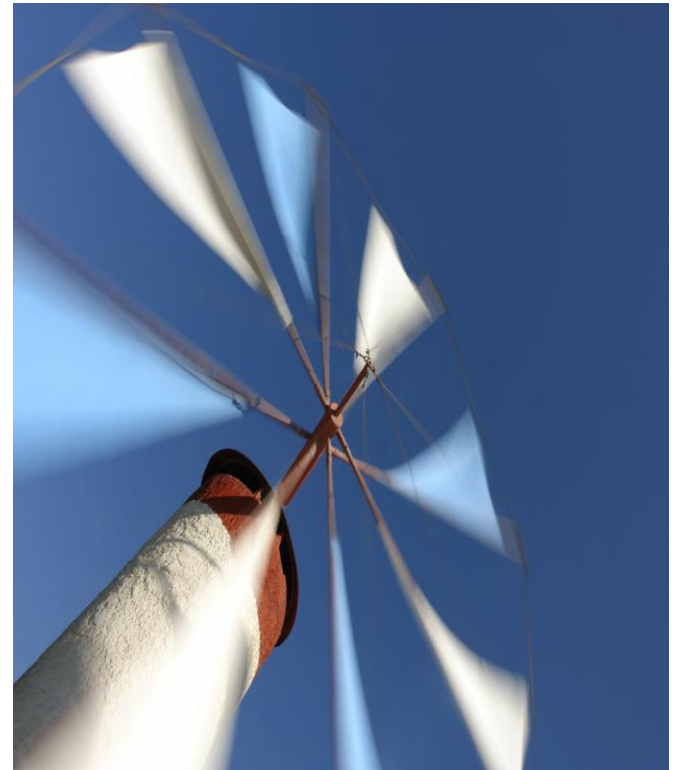


# Sea Change: Coal to Natural Gas

PJM Installed  
Capacity Cleared



## PJM Technology Initiatives:Future Tools



# Grid-Scale Energy Storage System – 32 MW Battery



## Laurel Mountain

### Wind Farm

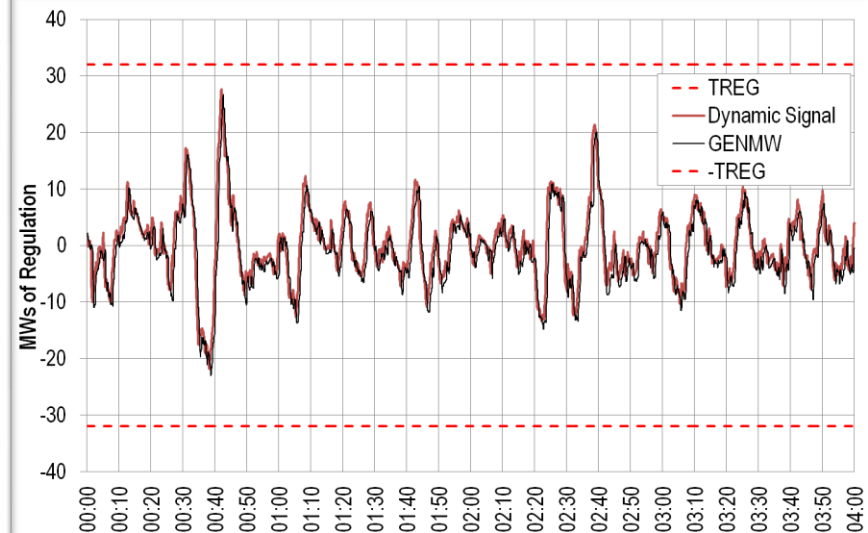
98 MW

61 turbines

### Battery Storage

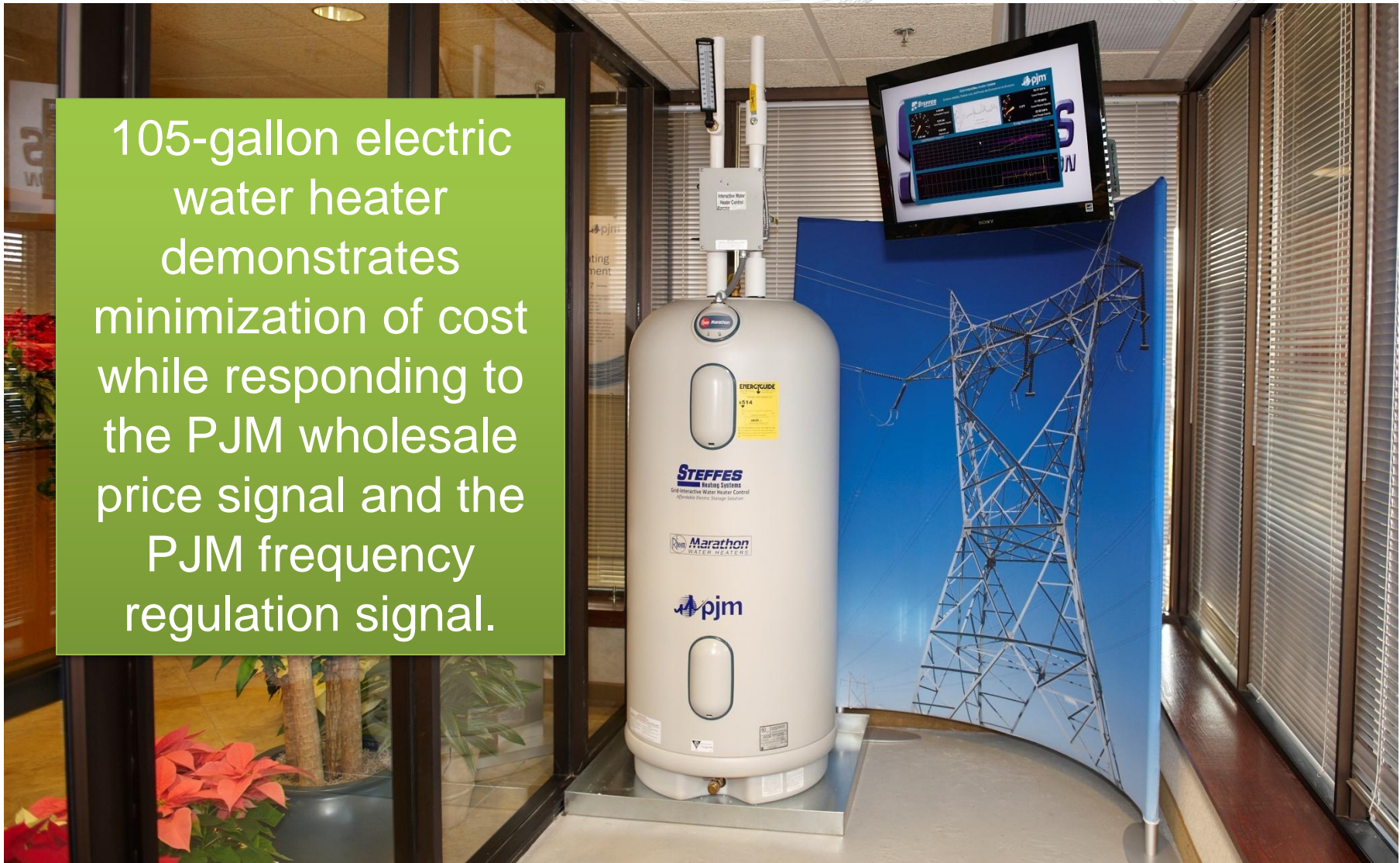
Lithium-ion (A123)

Power 32 MW, Energy 8 MWh





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





## Operational Details

- Altairnano, Inc – Lithium Ion nano titanate battery
- Power: 1 MW for 15 minutes
- Usable Charge Range: 5% - 99%
- Energy: 300 kWh
- Efficiency: 90% round trip



- Mid-Atlantic Grid Interactive Car Consortium (MAGICC)
- Over three years experience
- 5 aggregated vehicles
- Using Power Line Carrier (PLC) to send AGC signal to the vehicles via the SAE J1772 communication standard.



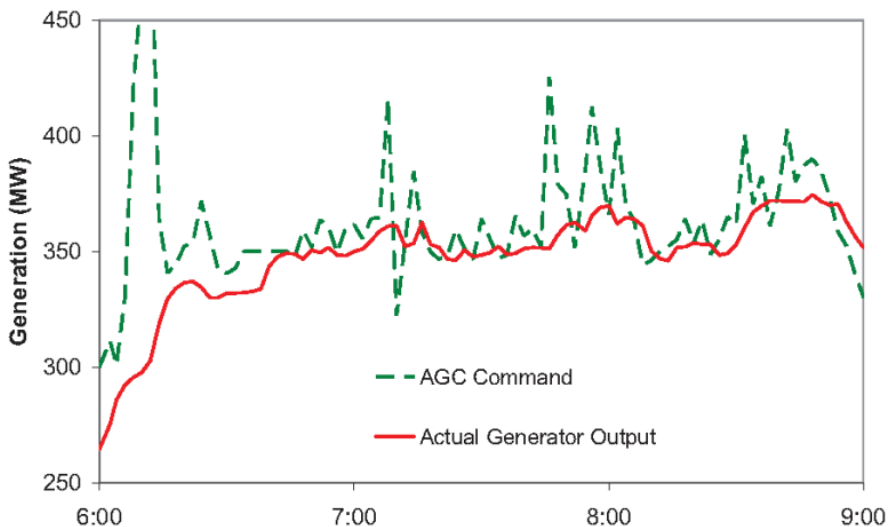


Available for full-time Summer job.

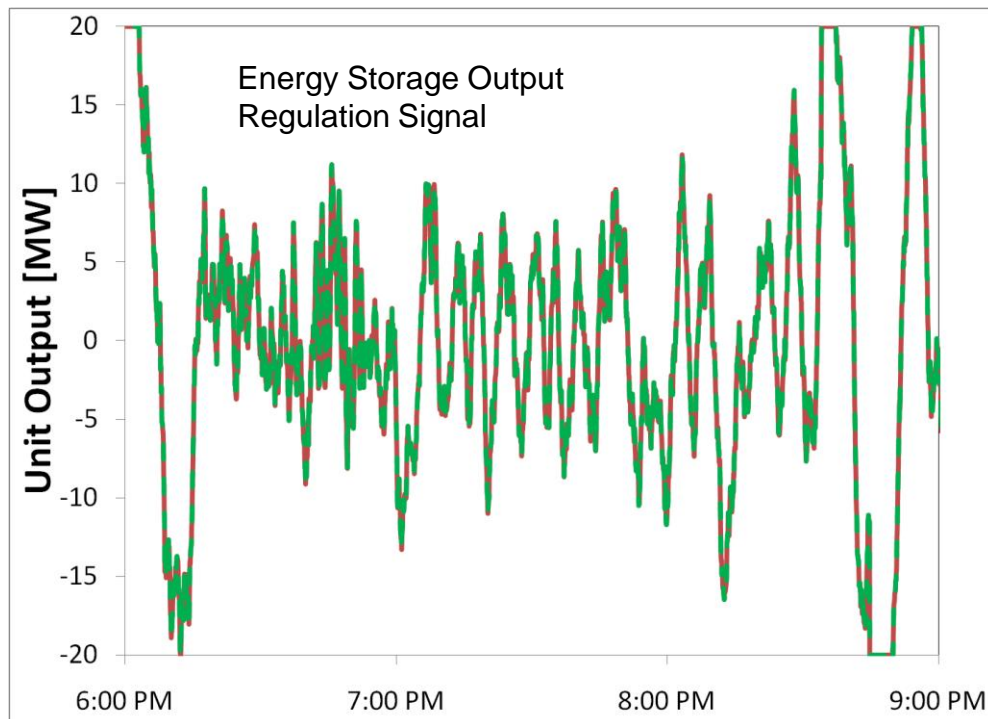


Not all MWs are created equal...

A steam unit following a regulation command signal (left)



Energy Storage accurately following a regulation command signal (right)

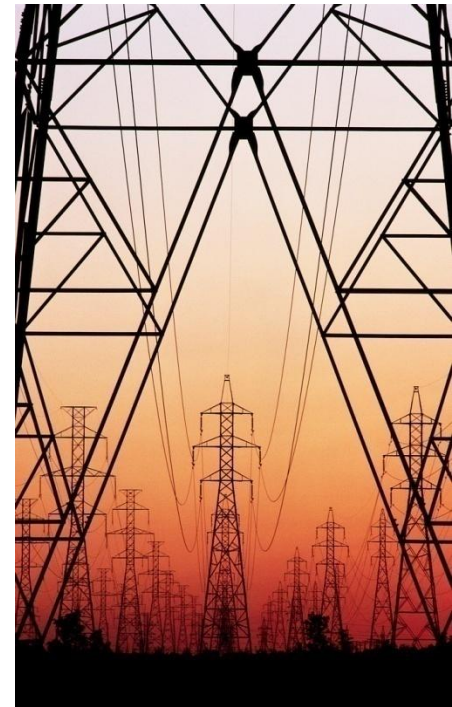




## Challenges:

### *Energy Storage: “Is It a Duck?”*

- How do we value it?
- How do we price it?
- How do we plan for it? *and*  
*Who Decides???*



## *Energy Storage: How do we value and price it?*

- A transmission asset: FERC rate base!
- A distribution asset: State rate base!
- Customer-owned equipment: Demand Side Response Compensation!
- Generation Partner: Market Clearing Price!
- Government Subsidies: Stimulus funds/tax credits!

## Planning for Energy Storage?

- Option A: Let generators “partner” with storage devices and bid total product into the market
- Option B: Transmission Planner orders strategically placed energy storage devices
- Option C: Customers use energy storage to meet their own needs and bids demand response into the market: *Dispatchability*
- Option D: State mandates through IRP process

## An Added Complication:

*Who Decides?*



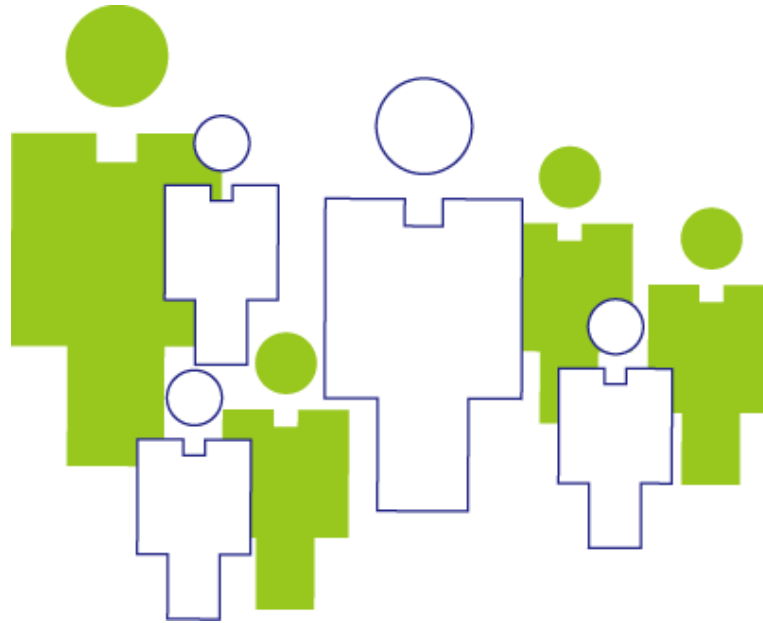
- States:
  - State Energy Policies: Governors/legislators
  - State PUCs
- FERC
- DOE
  - Stimulus Grants
  - Funded Research
  - Policy Development
- Environmental Agencies



*“Hanging in mid-air”*: a dangerous place



- A restructured industry or “Golden memories of yesteryear...”
  - The choice is ours





## LET'S TALK...

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