

# Energy Storage and the Grid: A Natural Match



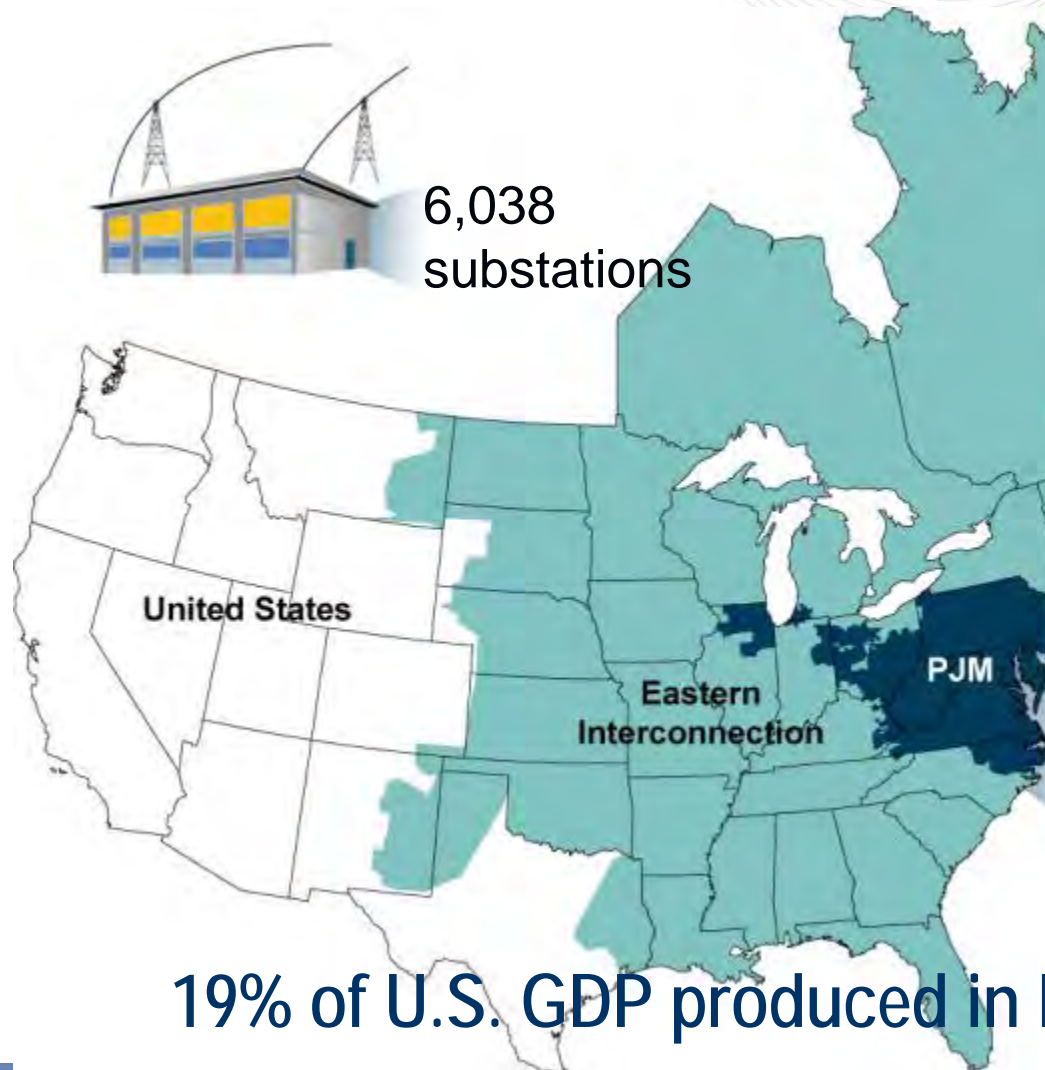
Craig Glazer  
Vice President - Federal  
Govt. Policy  
PJM Interconnection, L.L.C.



# PJM as Part of the Eastern Interconnection



6,038  
substations



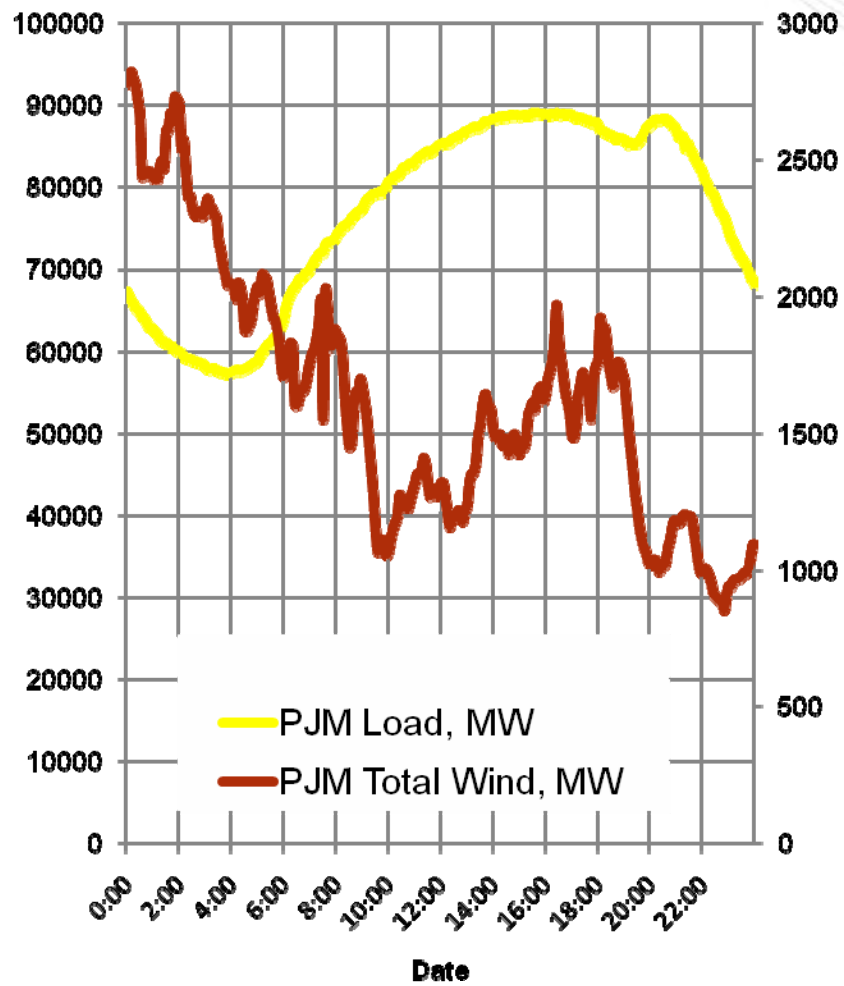
## KEY STATISTICS

PJM member companies	600
<b>Millions of people served</b>	<b>51</b>
Peak load in megawatts	144,644
MW of generating capacity	164,905
Miles of transmission lines	56,250
GWh of annual energy	729,000
Generation sources	1,310
Square miles of territory	164,260
<b>Area served</b>	<b>13 states + DC</b>
Internal/external tie lines	250

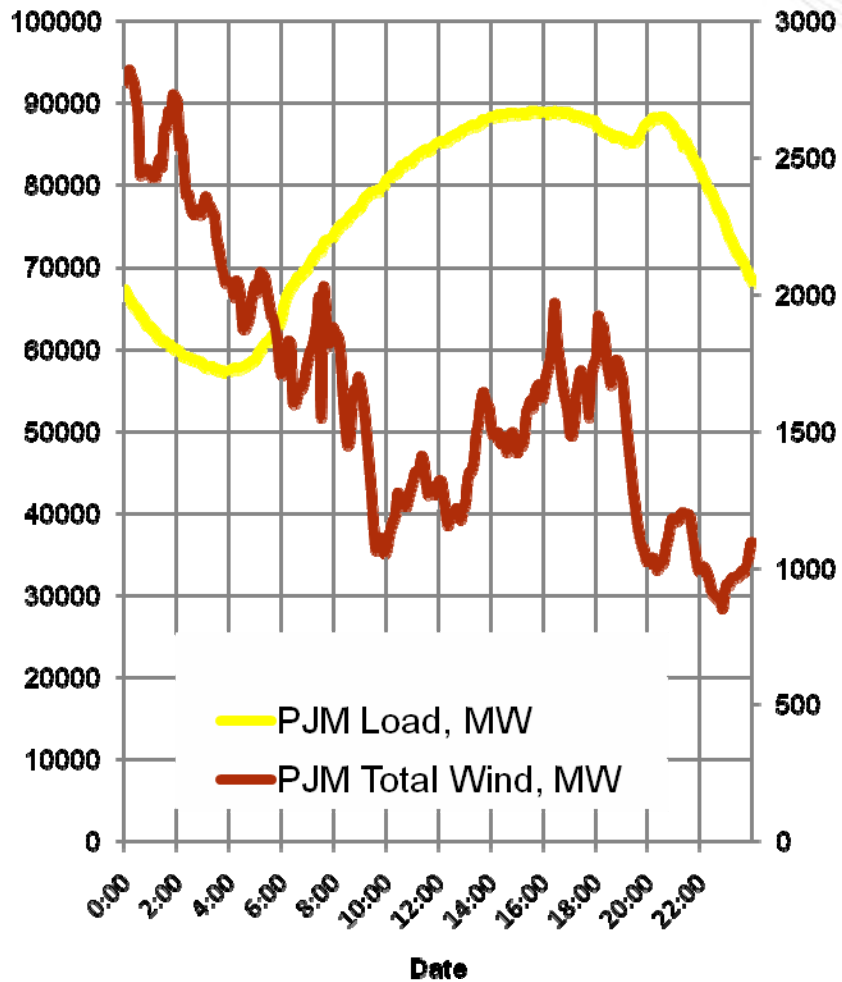
19% of U.S. GDP produced in PJM

- “The Airplane that Can Never Land” ...  
Keeping the grid in balance minute by minute
- Renewable Generation:
  - A Blessing and a Curse
    - No fuel costs
    - Variability and Intermittent
- Electric Vehicles: A Blessing and a Curse:
  - Potential source of energy storage vs.
  - New strain on the grid at peak times

## PJM Load and Total Wind on April 7, 2010

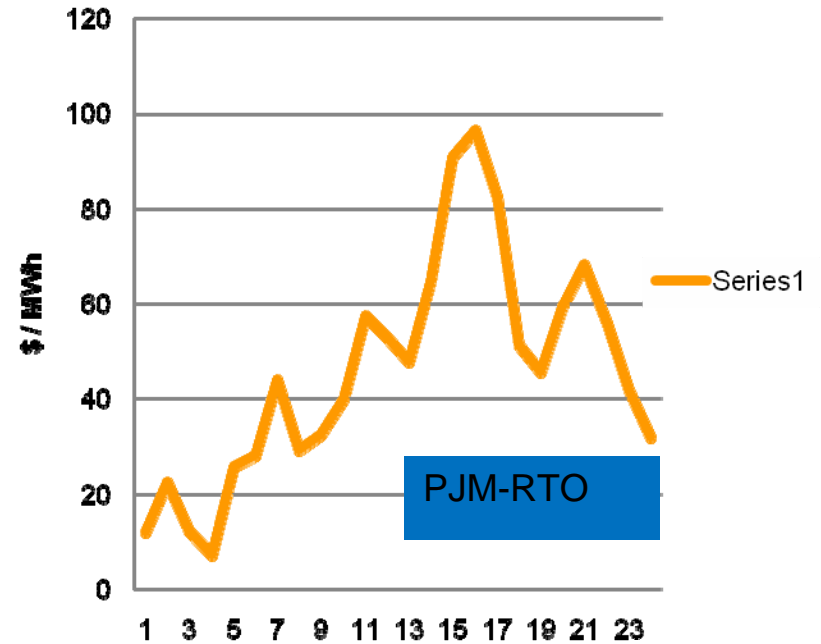


## PJM Load and Total Wind on April 7, 2010

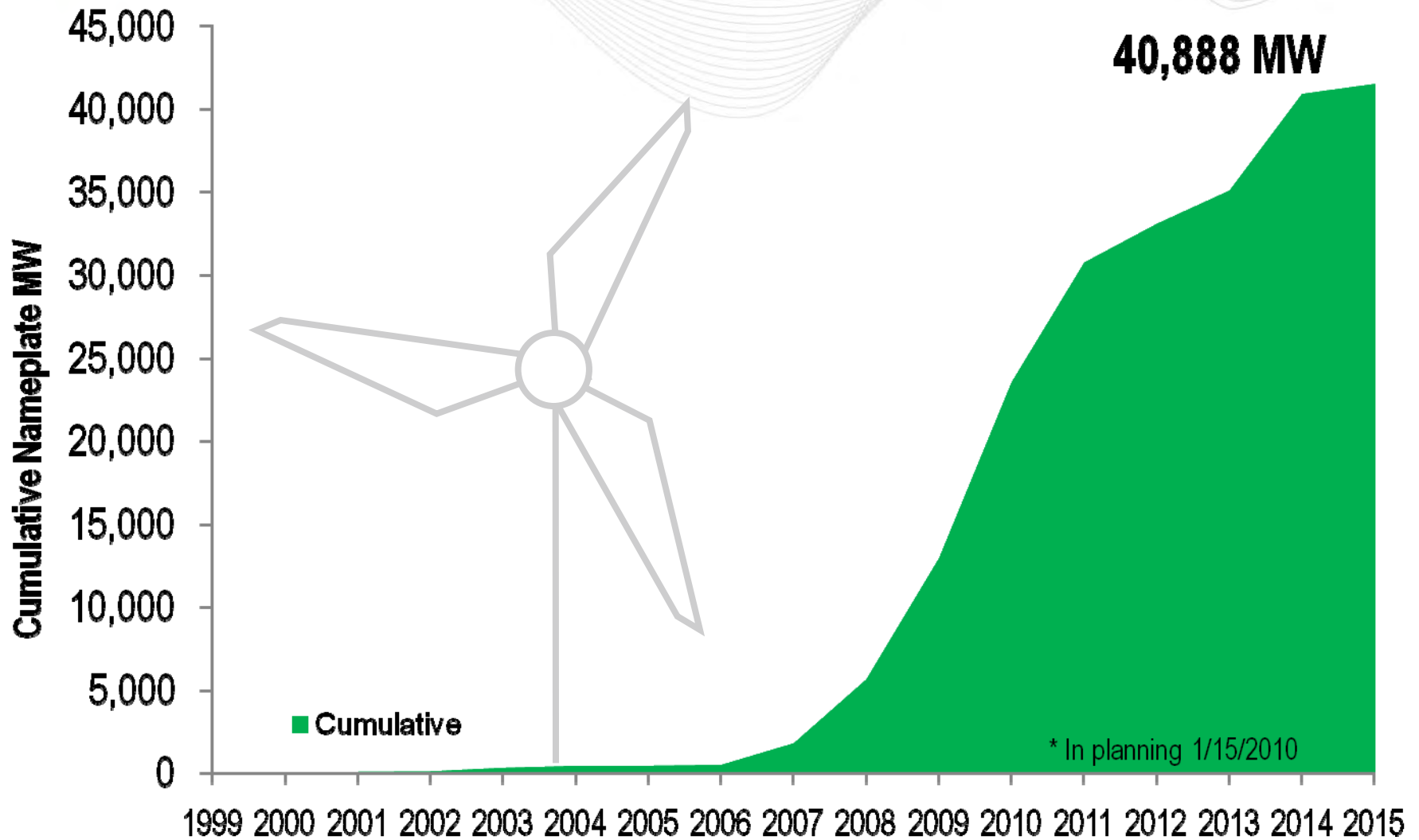


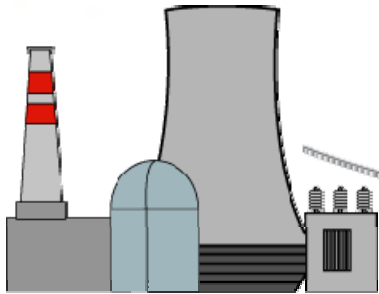
## Locational Marginal Prices

April 7, 2010



# Wind Generation in PJM - Operational and Proposed

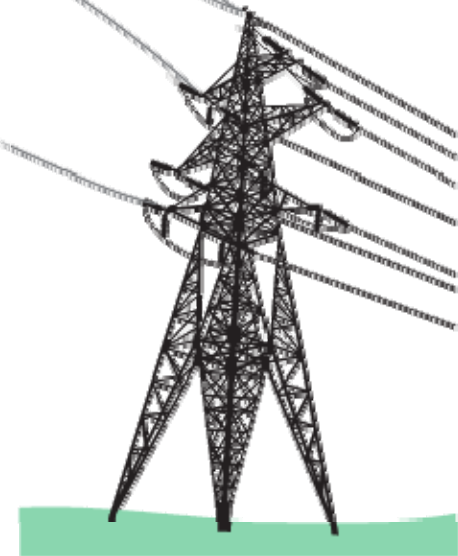




- If you like nuclear ...
- If you like clean coal ...



- If you like wind...



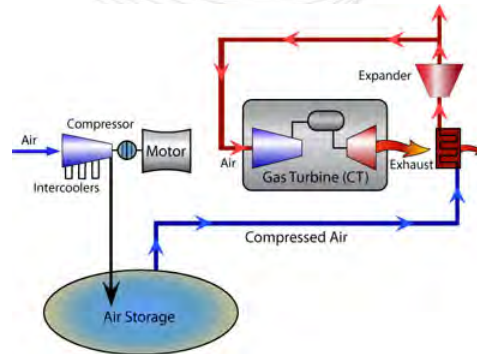
Bottom line....

**You have to love Storage**

# Grid Storage Types and Availability



Pumped Hydro



Compressed Air



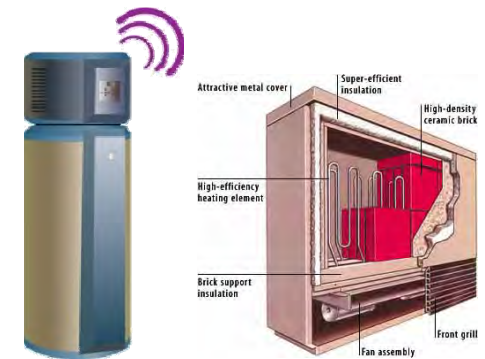
Flywheels



Stationary Battery



Mobile Batteries



Thermal



# Mid-Atlantic Grid Interactive Car Consortium V2G Demonstration Project



- Mid-Atlantic Grid Interactive Car Consortium (MAGICC)
- **Over 3 years experience** with the MAGICC battery electric vehicle responding to the PJM market signals

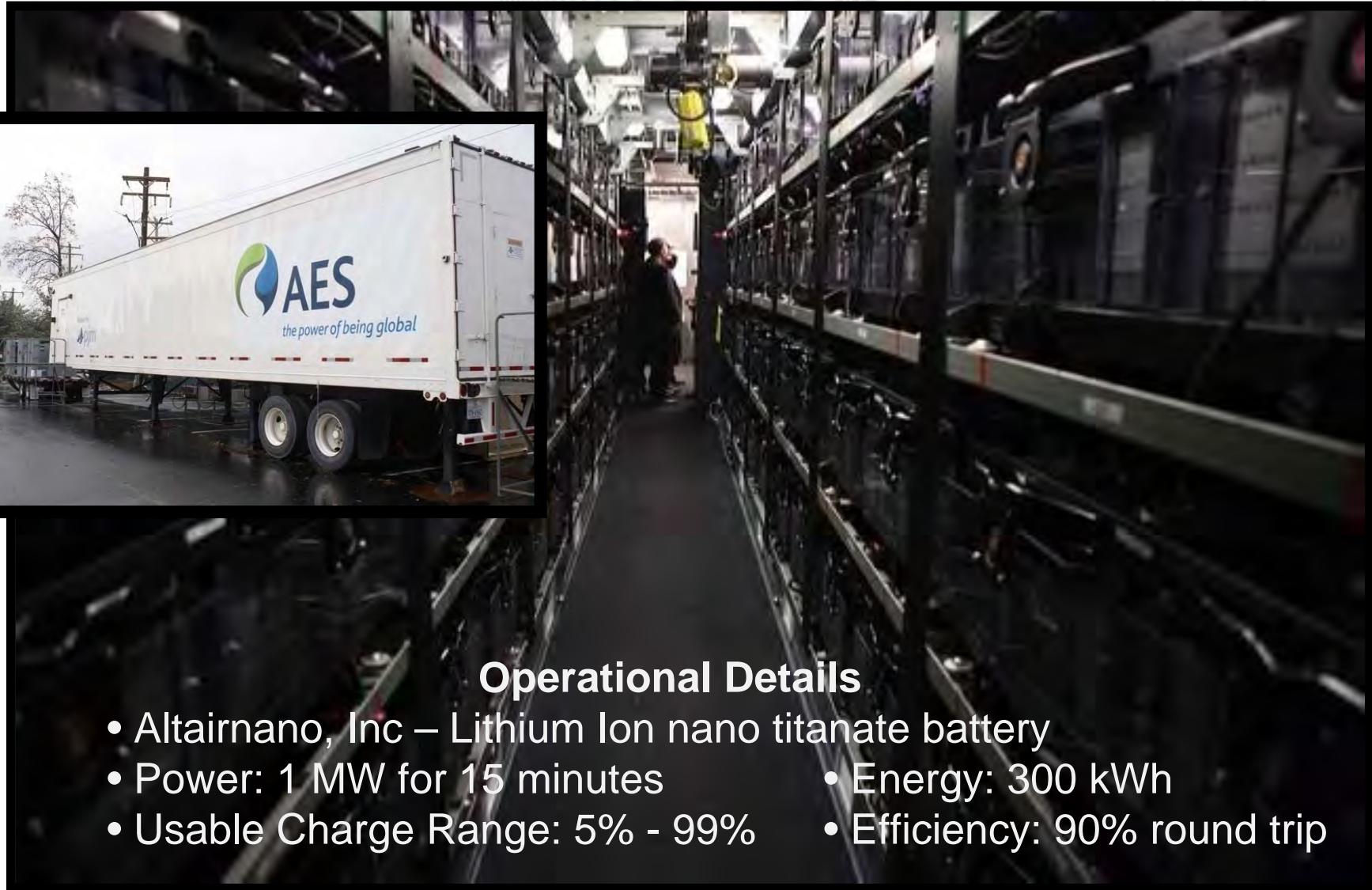


## Fleets are of particular interest

- Typically well established, consistent routes
- Return to same location for long term parking
  - Controlled infrastructure costs
  - Parked for 10-12 hours in low electric load periods
- Electric vehicle promotion







## 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

- Harmonizing State and Federal Regulation of Energy Storage: Is it a monopoly grid resource or a competitive asset?
- Paying for Performance: Awarding energy storage that can most quickly and effectively respond to immediate grid challenges.

- Funding the infrastructure for electric vehicles and other energy storage devices:
  - The ratepayers? Through state mandates? Federal mandates?
  - Through tax subsidies?
  - Through competitive markets?
  - A combination of the above?

## An Added Complication:

*Who Decides?*



- States:
  - State Energy Policies:  
Governors/legislators
  - State PUCs
- FERC
  - FERC Review of Planning
    - Who chooses projects?
- Local Governments
  - Zoning /siting  
laws/placement of  
infrastructure



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



# The Task Ahead: Blocking, Tackling & Teamwork!





LET'S TALK...



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