

Integrating Renewables

The National RPS Summit
Portland, OR
October 22, 2010

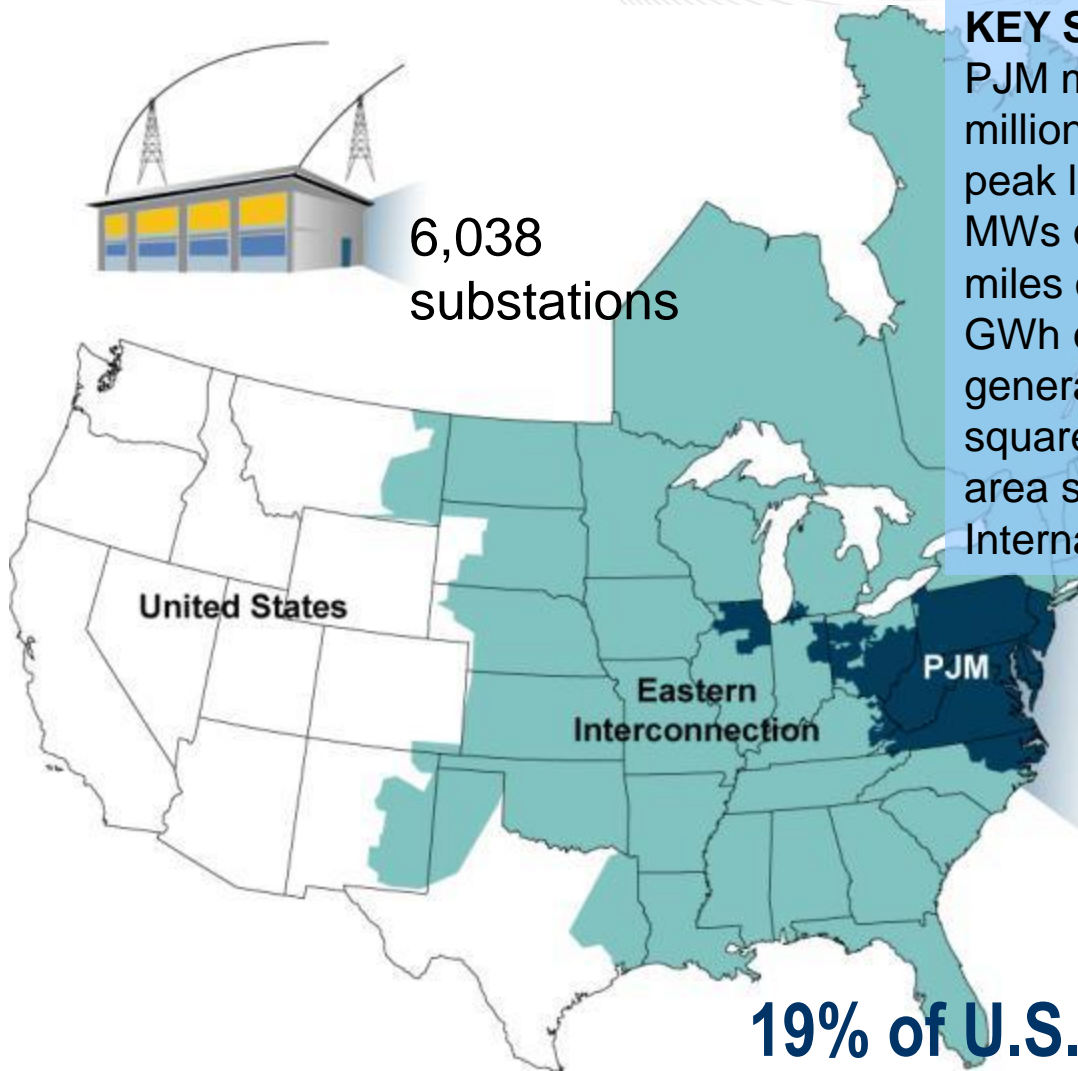
Timothy C. Burdis
Strategist



6,038
substations

KEY STATISTICS

PJM member companies	600
millions of people served	51
peak load in megawatts	144,644
MWs of generating capacity	164,905
miles of transmission lines	56,250
GWh of annual energy generation sources	729,000
1,310	
square miles of territory	164,260
area served	13 states + DC
Internal/external tie lines	250



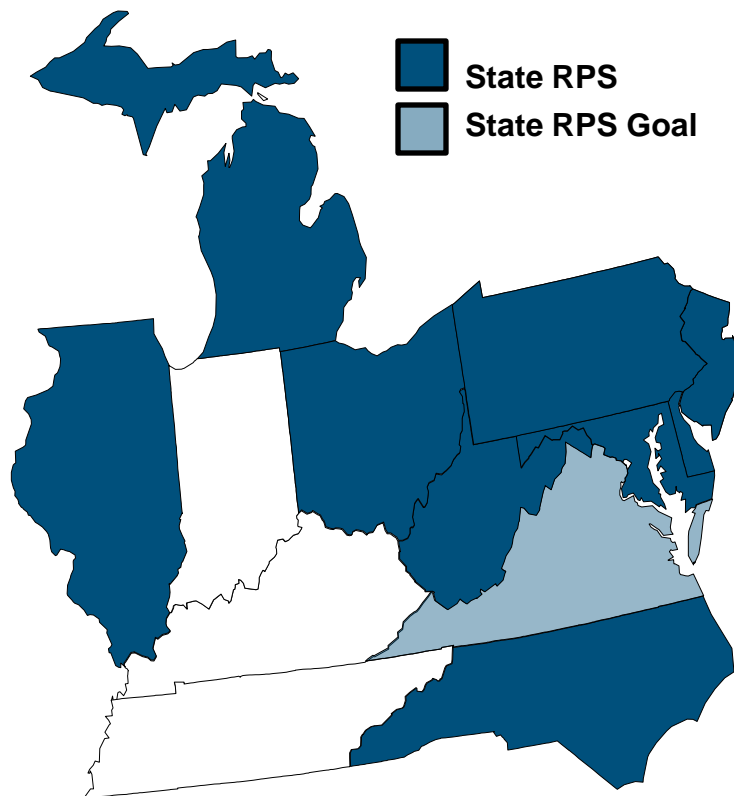
26% of generation in Eastern Interconnection

23% of load in Eastern Interconnection

19% of transmission assets in Eastern Interconnection

19% of U.S. GDP produced in PJM

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 [^]

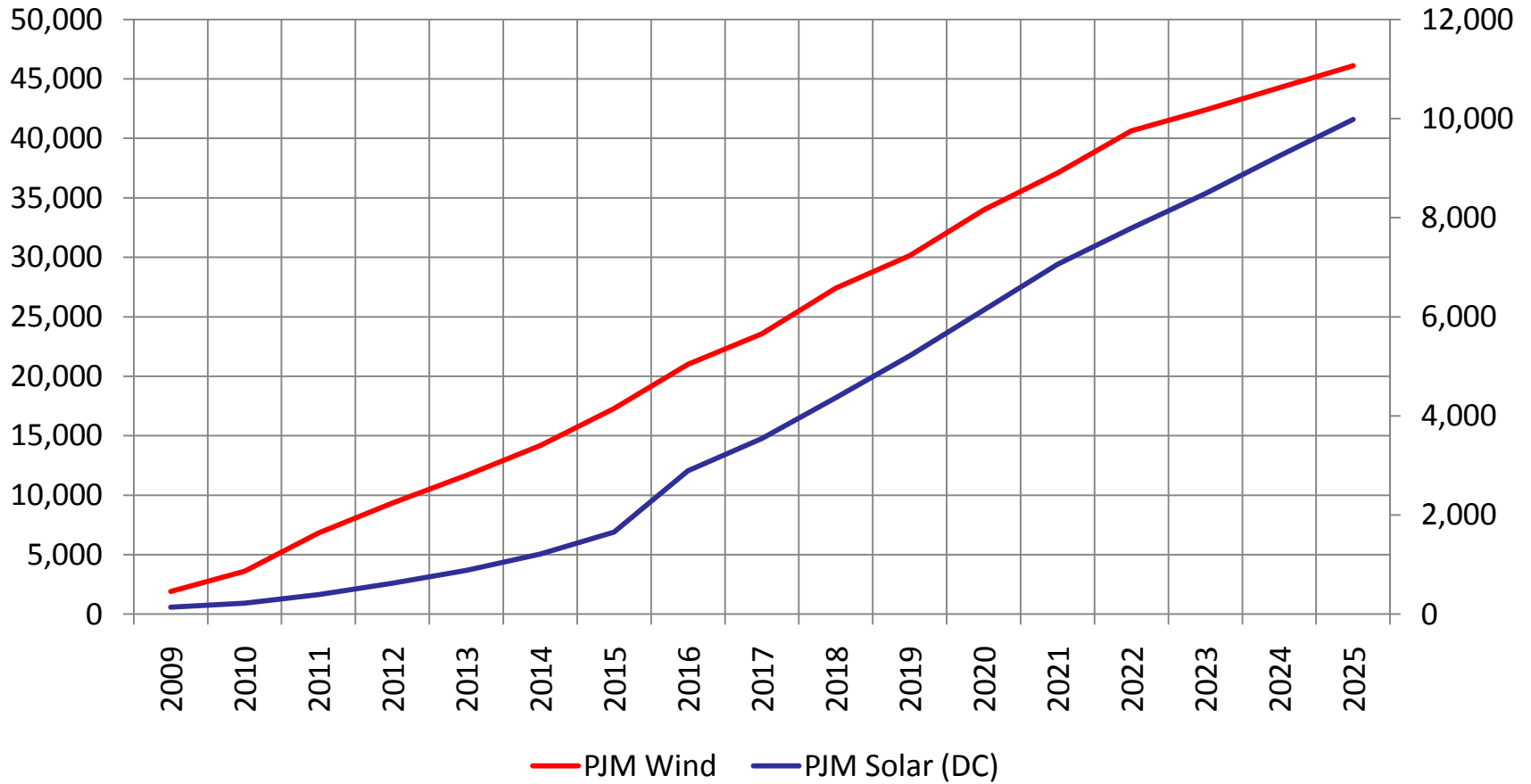
☀ Minimum solar requirement
[^] Extra credit for solar or customer-sited renewables
 ** Includes separate tier of “alternative” energy resources



Projected Renewable Project Requirements in PJM

By 2020: Estimated **34,000 MW** of wind and **6,000 MW** of solar will be required in PJM

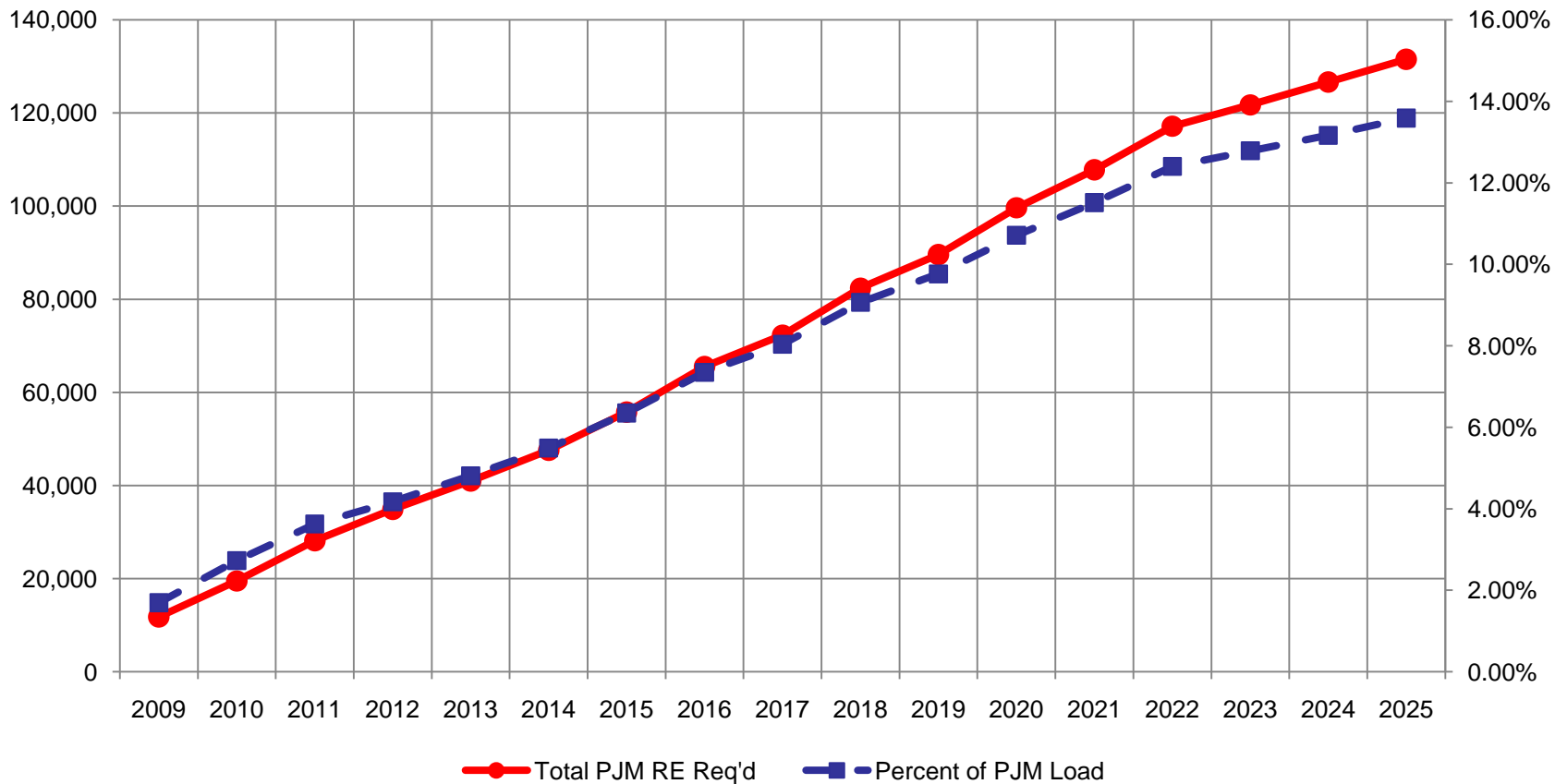
Wind and Solar Requirements in PJM (MW)



Projected Renewable Energy Requirements in PJM

By 2020: Estimated **100,000 GWh** of renewable energy, 10.7% of PJM annual net energy

Renewable Energy Required in PJM (GWh)





Wind
 ↑ 74%
 6,428,093 MWh - 2009
 12,837,460 MWh - cumulative



Solar
 ↑ 3171%
 81,128 MWh - 2009
 84,561 MWh - cumulative



Hydro
 ↑ 29%
 9,078,714 MWh - 2009
 36,728,808 MWh - cumulative



Pumped Storage
 ↑ 3%
 6,629,555 MWh - 2009
 31,427,381 MWh - cumulative



Captured Methane
 ↑ 19%
 3,159,738 MWh - 2009
 11,099,537 MWh - cumulative



Other Gas
 ↑ 28%
 651,569 MWh - 2009
 2,730,861 MWh - cumulative



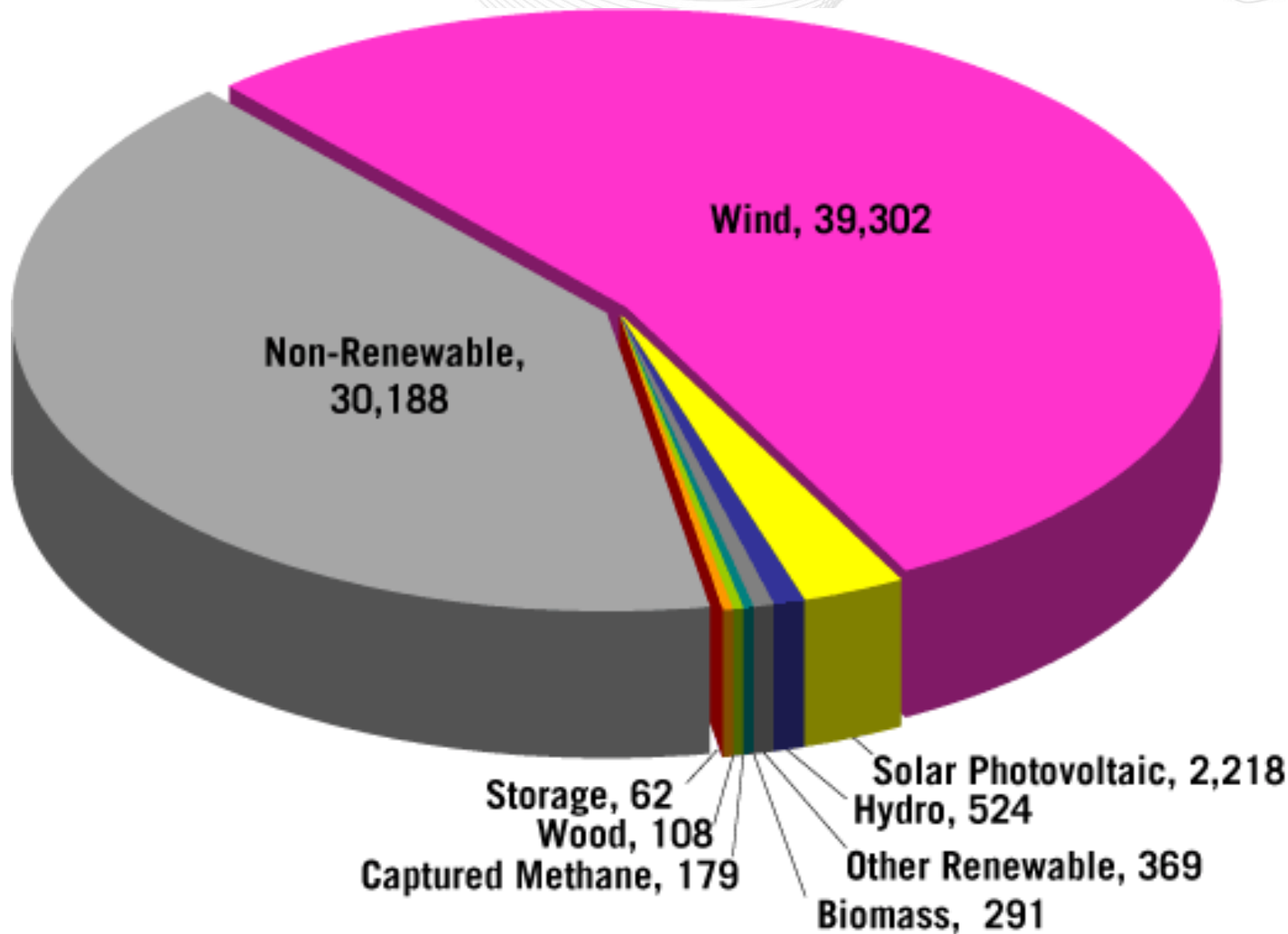
Solid Waste
 ↓ -2%
 4,189,614 MWh - 2009
 21,216,061 MWh - cumulative



Wood Waste
 ↓ -10%
 3,604,475 MWh - 2009
 15,606,523 MWh - cumulative

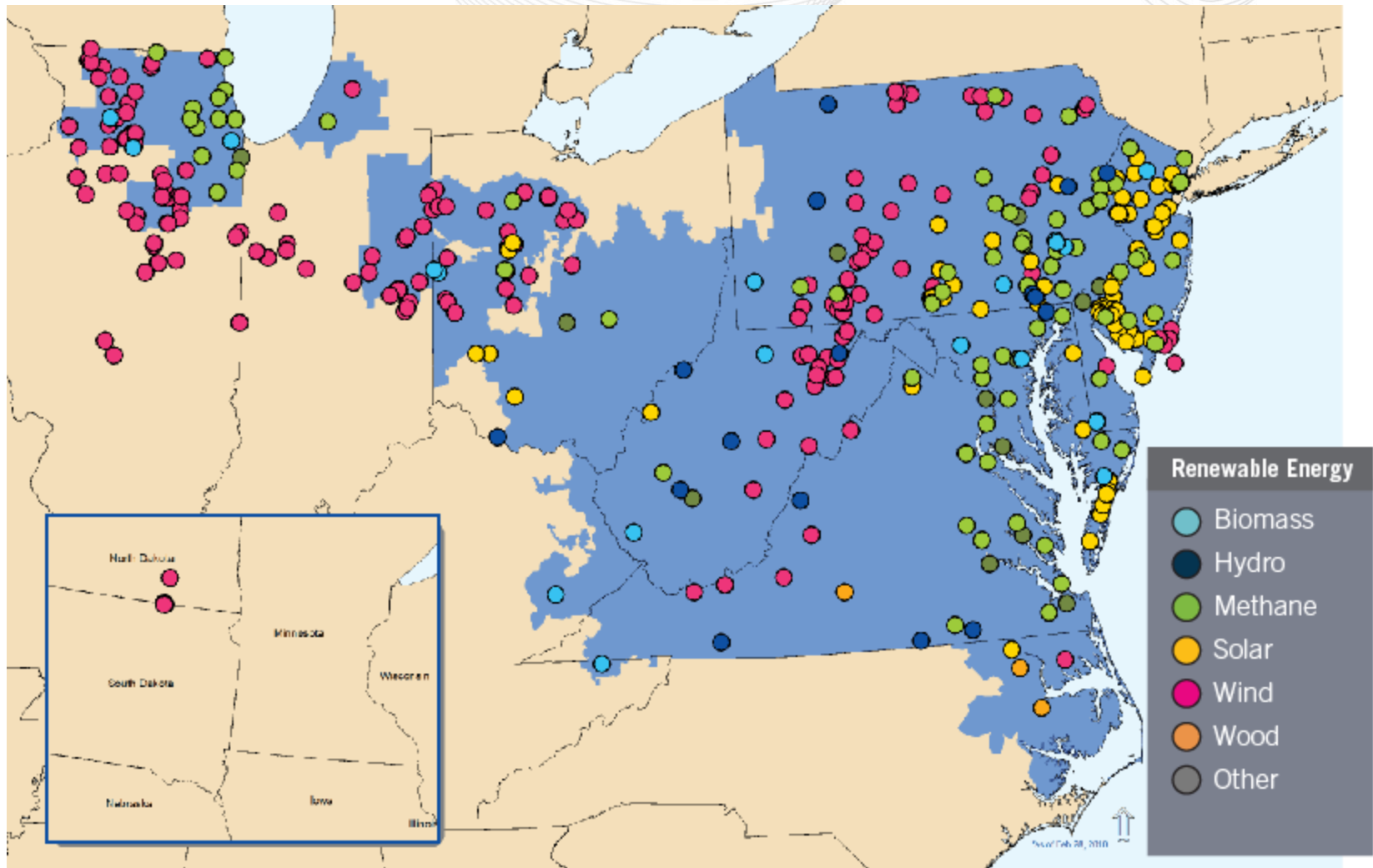
- MWh of renewable energy produced in 2009;
- Cumulative MWh since tracking began in 2005;
- Percent change between 2009 and 2008.

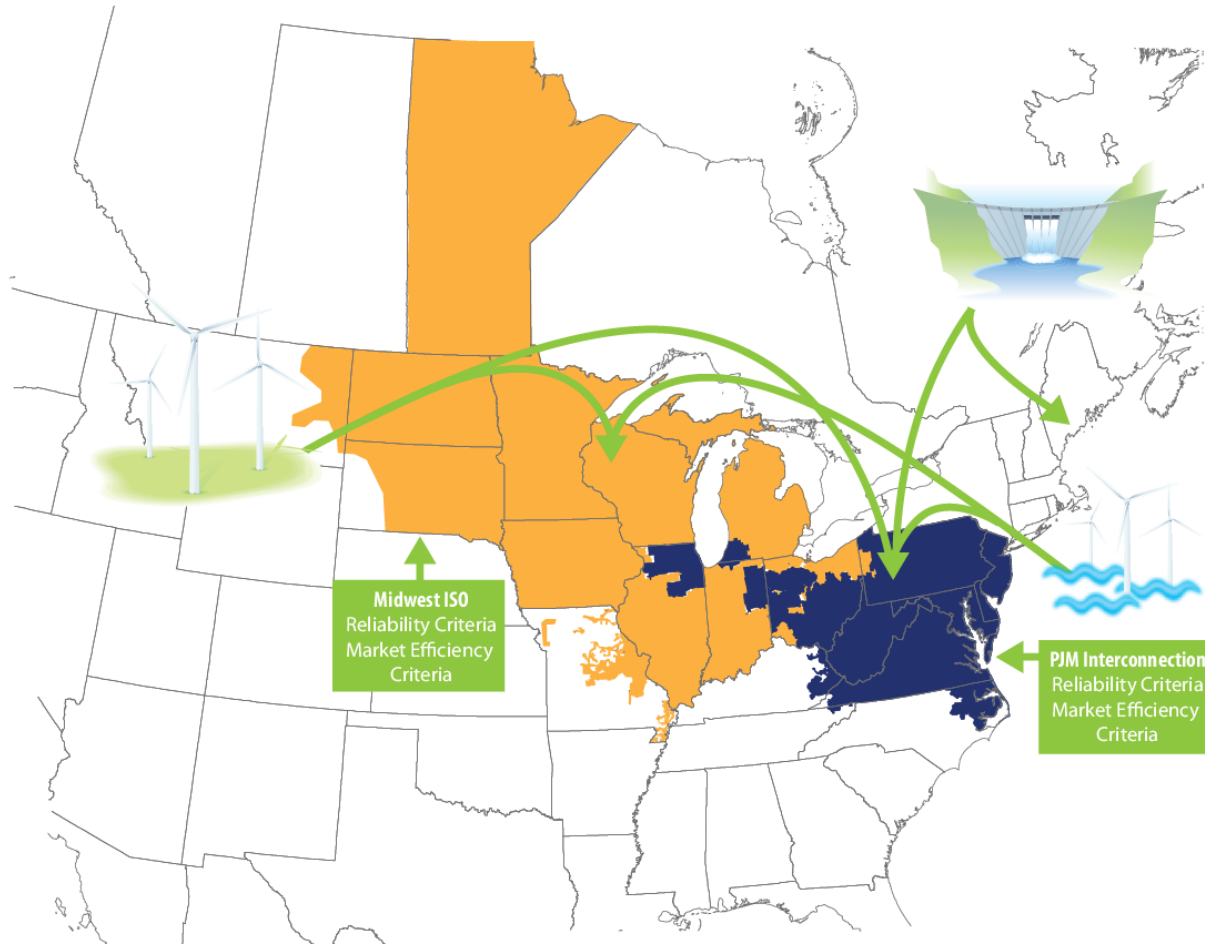
Proposed Generation (MW)

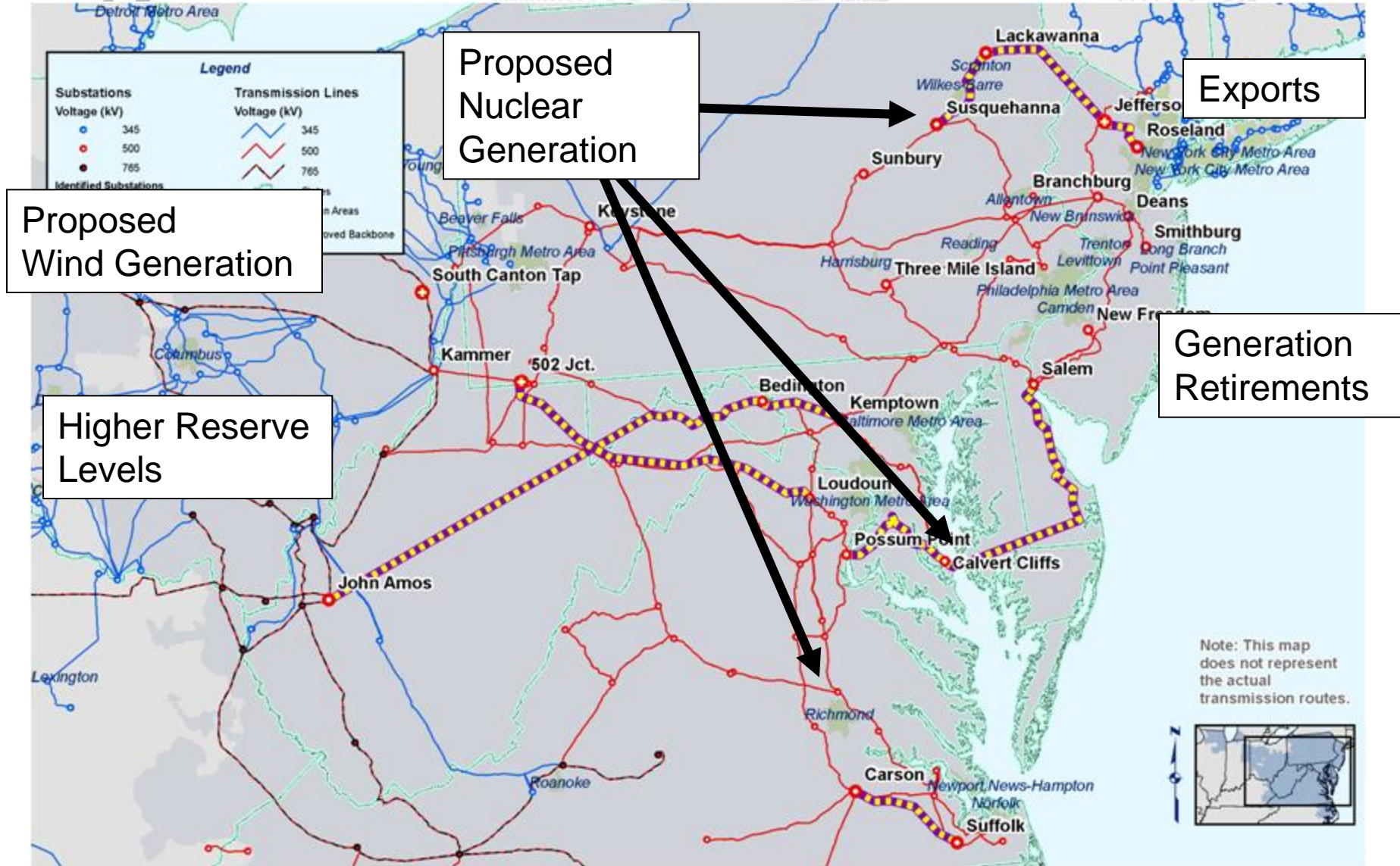


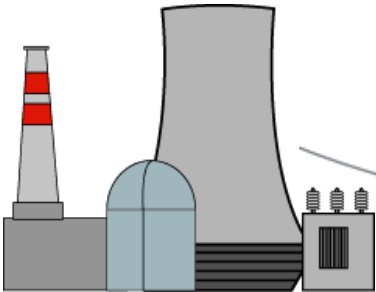
As of July 13, 2010

Proposed Renewable Generation in PJM









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



Bottom line....

You have to love Transmission.

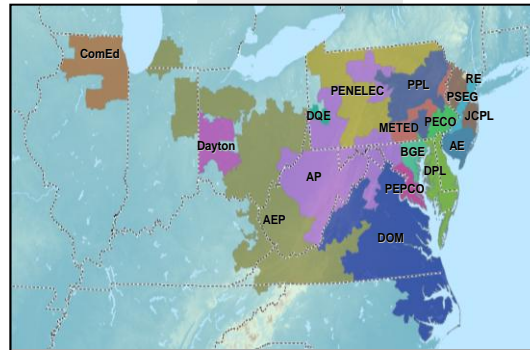


Organized Competitive Wholesale Markets Regional Planning Process

The RTEP process identifies upgrades to meet customers' requirements:

- operational
- economic
- reliability requirements

Broad system view that looks out 15 year over the entire geographic area



Eastern Interconnection Planning Collaborative

- Rolls-up regional plans
- Coordinates with Canada, Western Interconnect and Texas
- Receives stakeholder input and holds public meetings
- Performs studies of various transmission alternatives against national, regional and state energy/economic/environmental objectives
- Identifies gaps for further study

Publishes Annual Interconnection Analysis



Annual interconnection analysis



- States**
- Regional Policy recommendations
 - State energy policies

Provides policy direction, assumptions & criteria



DOE/FERC

Regional/state compliant plans provided as input

Study gaps relative to national, regional and state policy



FERC

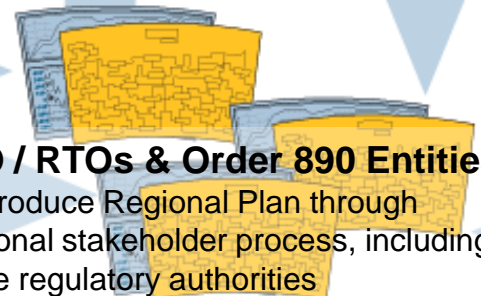
- Review/direction
- Order adjustments
- Cost recovery

Regional Plans

- States**
- Policy recommendations
 - State energy plans

ISO / RTOs & Order 890 Entities

- Produce Regional Plan through regional stakeholder process, including state regulatory authorities



- Formed the Intermittent Resource Working Group (IRWG) to address market, operational, and reliability issues specific to variable resources.
- Implemented a centralized wind power forecasting service in April 2009 for use in PJM reliability assessments:
 - Day Ahead (Medium-Term Wind Power Forecast)
 1. predict day-ahead congestion and mitigating strategies
 2. ensure sufficient generation resources are scheduled to meet reserve requirements
 - Real-Time (Short-Term Wind Power Forecast)
 1. evaluate current day congestion
 2. ensure that sufficient generation resources are available to respond to real-time or projected fluctuations in Wind Power Output.
- Implemented changes to improve wind resource management in June 2009.
 - Generating resources are now able to submit negative price offers, enabling wind resources to submit flexible offers that better reflect the price at which they will reduce output.

- In November 2009 the IRWG started work on new assignments :
 1. Assessing operational impacts
 2. Examining interconnection standards
 3. Reviewing interconnection study methodologies for intermittent resources
 4. Implementing changes for Energy Storage Resources
- PJM Operations Planning is proposing changes to:
 - Improve communication/coordination when a wind farm has multiple owners/operators
 - Improve dispatch and control by ensuring that economic minimums are not set too high.
- PJM is participating in NERC Integration of Variable Generation Task Force (IVGTF)

ISOs and RTOs reduce intermittent resource integration costs:

Characteristic	Impact to Wind Integration Cost
Larger balancing areas	<ul style="list-style-type: none"> • Reduces overall increase in variability • Less regulation and ramping service required
Faster markets, i.e., shorter scheduling intervals (5-15 minutes)	<ul style="list-style-type: none"> • Less regulation required to accommodate intra-hour variations
Larger geographic area	<ul style="list-style-type: none"> • Increases wind diversity and reduces overall variability
Centralized wind power forecasting	<ul style="list-style-type: none"> • Cost-effective approach to reduce scheduling impacts

- Flexible resources will be needed to offset the impacts of variable generating resources
- New market players:
 - Price Responsive Demand
 - Smart Grid Technologies
 - Energy Storage Resources
 - battery arrays
 - flywheels
 - compressed air energy storage
 - plug-in hybrid electric vehicles (PHEVs)

Contact:

Timothy C. Burdis
Strategist – Market Strategy
PJM Interconnection, LLC.

610.666.4521

burdit@pjm.com