Americans for a Clean Energy Grid

Regional Transmission Webinar Series

PJM-Interconnection

Who we are and what we do:

We support policies that modernize the nation’s electric power network and unlock clean energy and economic opportunities across the country. The backbone of a clean electricity system and a strong economy is a resilient and reliable transmission grid. Smart state and federal policies that improve the way the grid is developed, planned, and paid for will help it become a more robust, reliable, and secure network that supports expansion of renewable energy, competitive power markets, energy efficiency, and lower costs for consumers.

Regional Transmission Summits

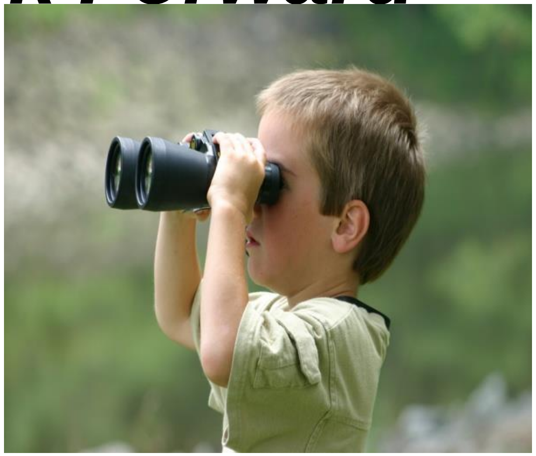
- Minnesota (Great Plains)
- Oregon (Pacific Northwest)
- Iowa (Midwest)
- Kansas (Heartland)
- Massachusetts (New England)
- Ohio (PJM-Interconnection)
- Nashville (Southeast)
- Denver (Rocky Mountain)

Regional Transmission Webinar Series

- Pacific Northwest *(Concluded)*
- Midwest *(Concluded)*
- Heartland – *(Concluded)*
- New England – *(Concluded)*
- PJM – January 24th, 2014
- Southeast – Week of February 3rd *(tbd)*
- Rocky Mountain – Week of February 17th *(tbd)*
- Great Plains - *(To Be Determined)*
- National - *(To Be Determined)*
  - *Stay tuned for exact dates*

ENVIRONMENT AND RELIABILITY IN A RESTRUCTURED ELECTRICITY WORLD…

Looking Backward to Look Forward



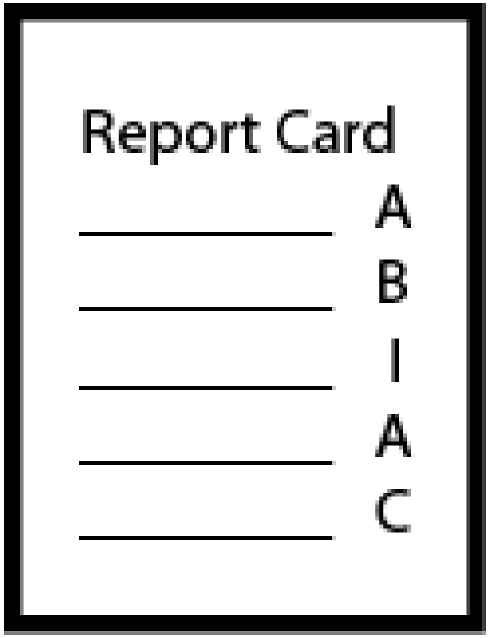
Craig Glazer
Vice President
PJM Interconnection

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

- Electric Rates Far Above National Average
- Price Spikes of the mid-1990’s
- Special Contracts: “*What’s My Competition Getting and Why Can’t I Get it Too?”*
- Risks borne by the customer: *Affiliate mines, stranded costs, nuclear cost overruns,PURPA “must purchase” contracts …*

- Price Spikes---Lack of Transparency
- Price Squeeze: “Refunds to a corpse”
- Interconnection Costs— “Take it or leave it”
- Demand ratchets, “take or pay” agreements…you name it…

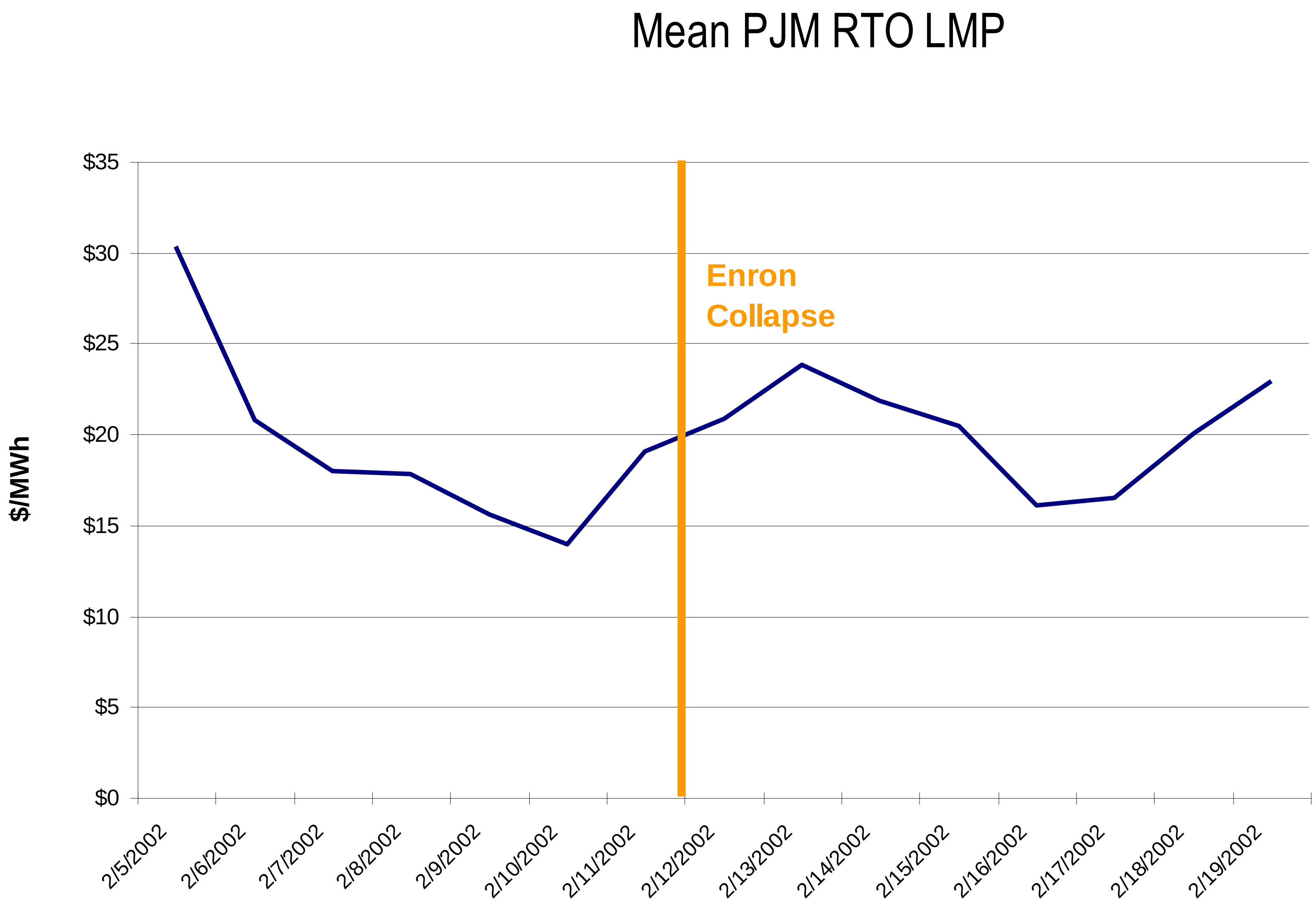
- Reminding the Regulator What We Got Right: *Taking credit for our accomplishments*
- Building on Past Experience: *Learning What Needs Further Work*
- Avoiding the Quagmire of Inaction



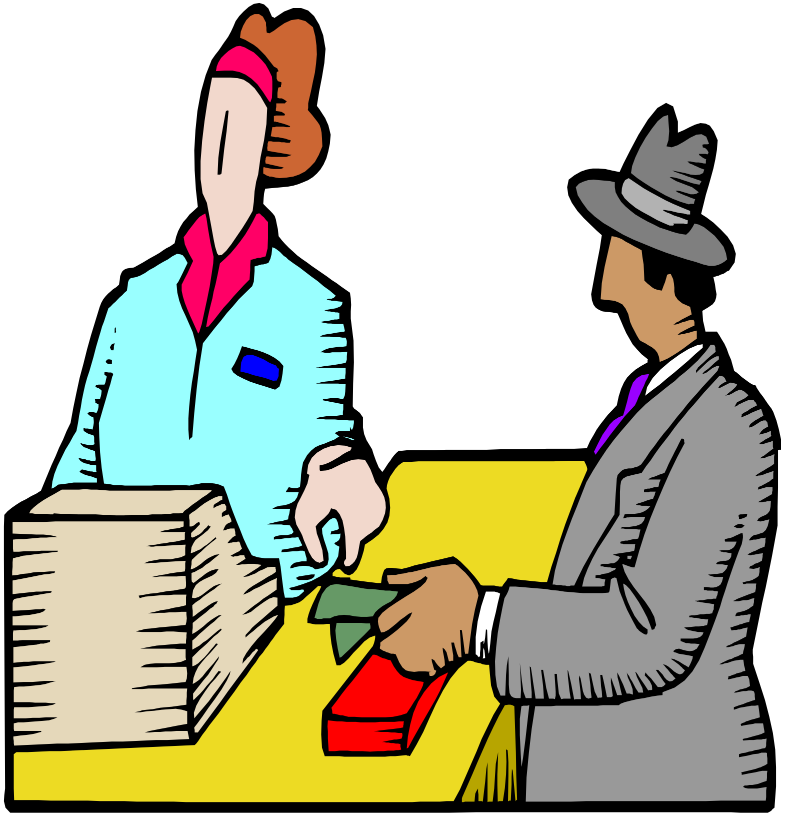
Accomplishment No. 1:

We moved the Risk Allocation Formula:

aka “There was no Enron rate case!


Mean PJM RTO LMP
$/MWh
$35
$30
$25
$20
$15
$10
$5
$0
Enron
Collapse
2/5/2002
2/6/2002
2/7/2002
2/8/2002
2/9/2002
2/10/2002
2/11/2002
2/12/2002
2/13/2002
2/14/2002
2/15/2002
2/16/2002
2/17/2002
2/18/2002
2/19/2002

- 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

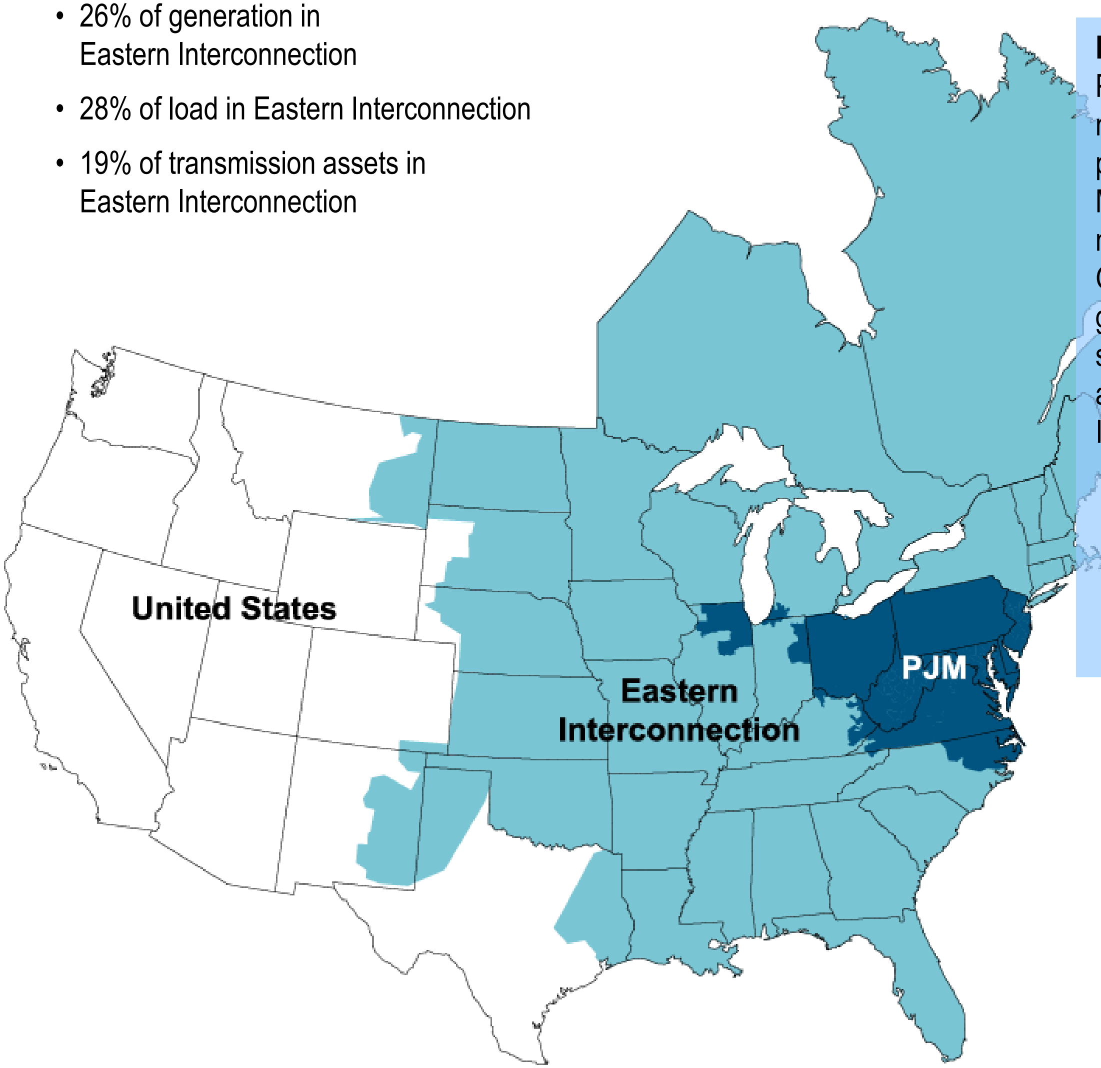


Accomplishment No. 2:

We got the fundamentals right!

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

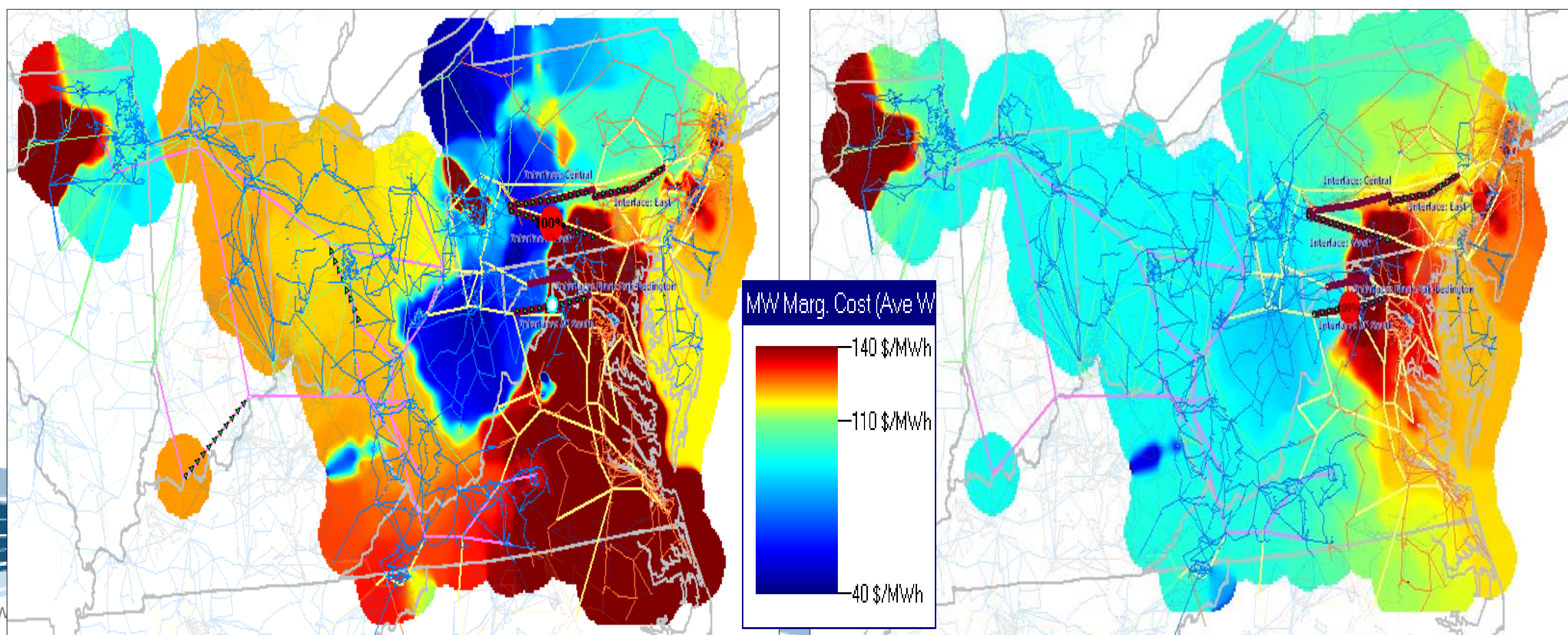
As of 1/4/2012

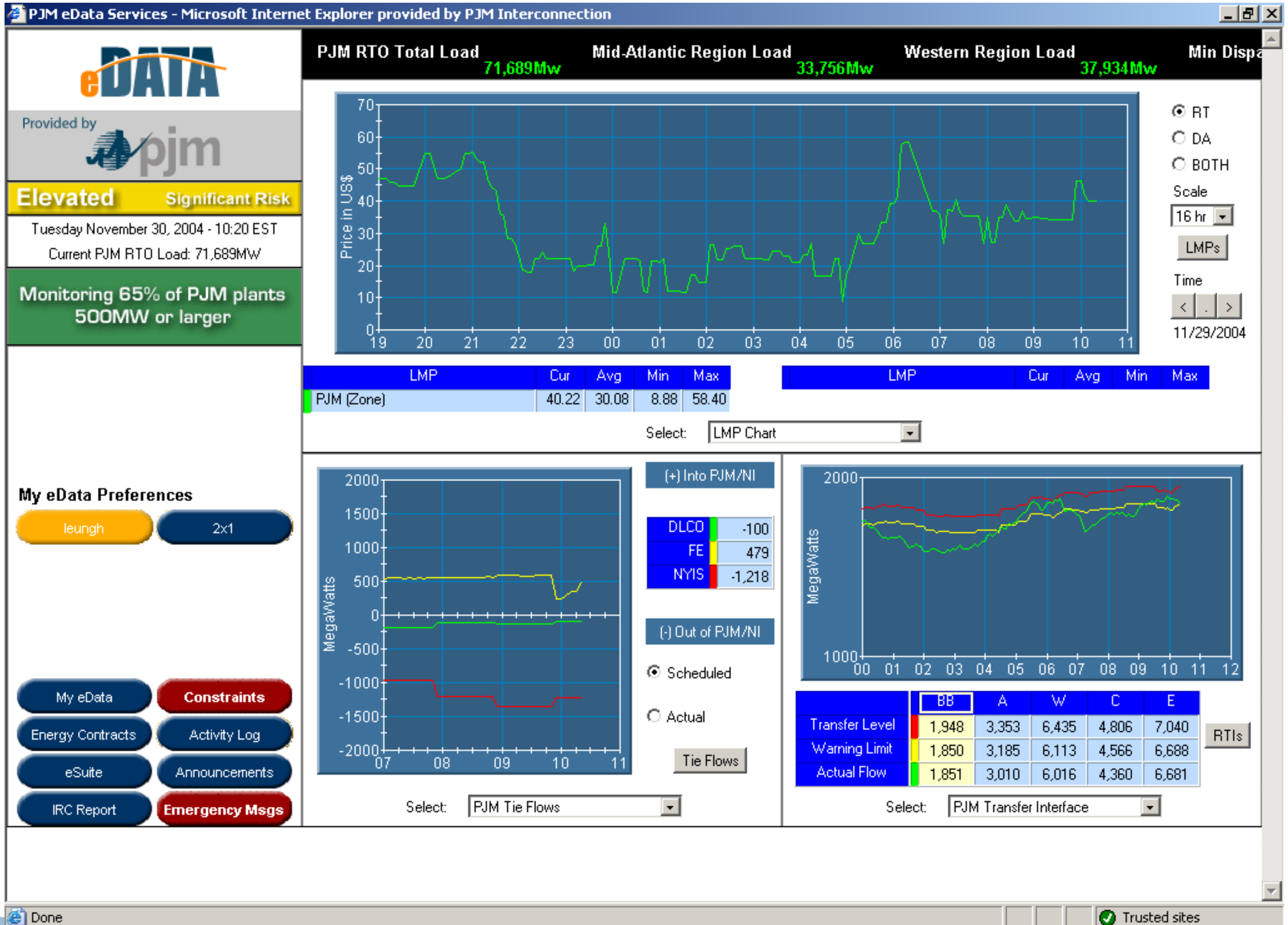
Energy Market: Increased Efficiency

- **Lower energy prices across the expanded PJM region**
  - ESAI’s technical study: region-wide energy price without integration would be \$0.78/MWh higher in 2005 than with integration.
  - Spreading these savings over the total PJM RTO’s energy demand of 700 terawatt-hours (TWh) per year yields aggregate savings of over \$500 million per year.

Pre-Integration Price Pattern

Post-integration Energy Price Pattern




PJM eData Services - Microsoft Internet Explorer provided by PJM Interconnection
PJM RTO Total Load 71,689Mw
Mid-Atlantic Region Load 33,756Mw
Western Region Load 37,934Mw
Provided by pjm
Elevated Significant Risk
Tuesday November 30, 2004 - 10:20 EST
Current PJM RTO Load: 71,689MW
Monitoring 65% of PJM plants 500MW or larger
My eData Preferences
My eData
Constraints
Energy Contracts
Activity Log
eSuite
Announcements
IRC Report
Emergency Msgs
RT
DA
BOTH
Scale
16 hr
LMPs
Time
11/29/2004
LMP Cur Avg Min Max
PJM (Zone) 40.22 30.08 8.88 58.40
Select: LMP Chart
(+) Into PJM/NI
DLCO -100
FE 479
NYIS -1,218
(-) Out of PJM/NI
Scheduled
Actual
Tie Flows
Select: PJM Tie Flows
Transfer Level 1,948 3,353 6,435 4,806 7,040
Warning Limit 1,850 3,185 6,113 4,566 6,688
Actual Flow 1,851 3,010 6,016 4,360 6,681
RTIs
Select: PJM Transfer Interface
Done
Trusted sites

Accomplishment No. 3

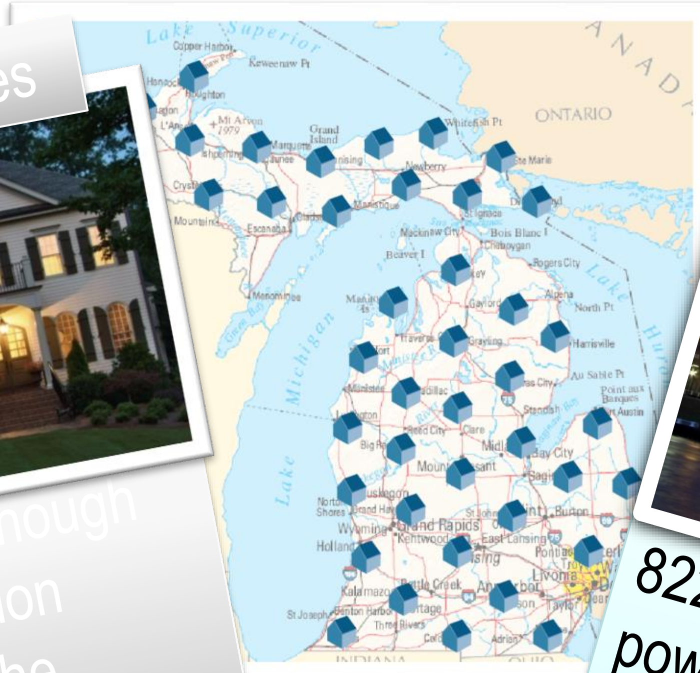
New Players and new tools to meet future demand:

- Demand Side Response
- Energy Efficiency
- Smart Grid

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

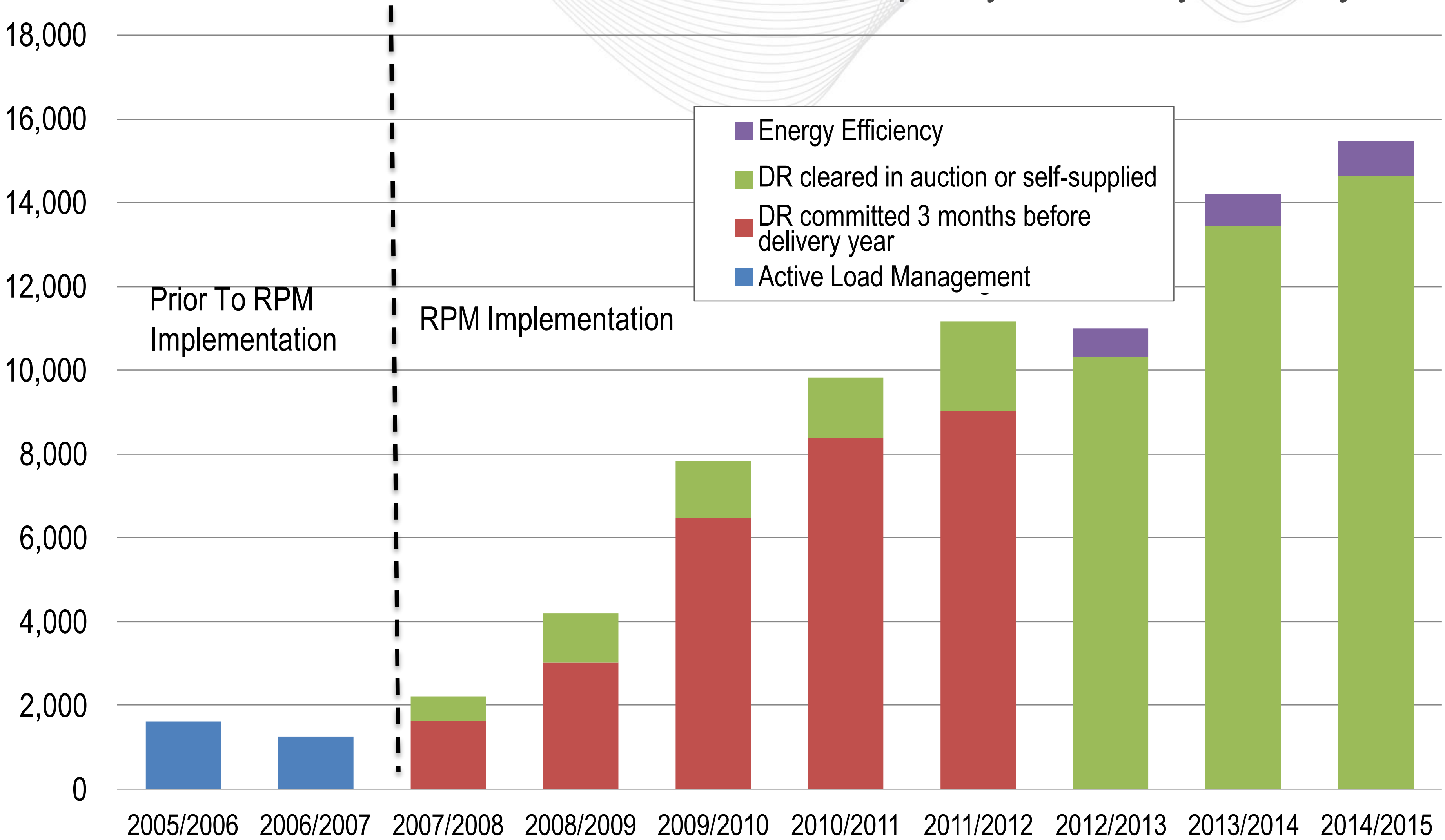


Energy Efficiency

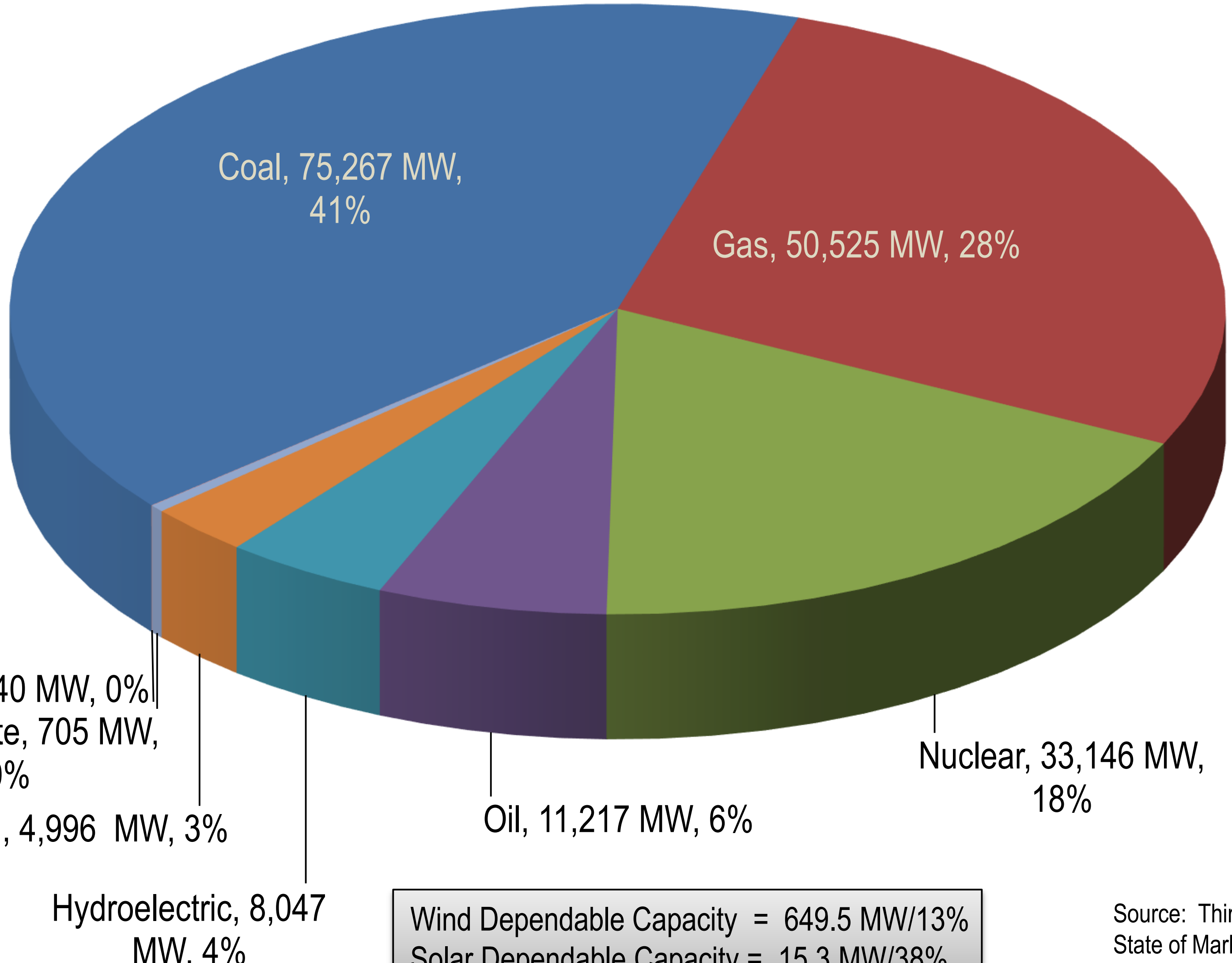
822 MW or enough to power 149,000 households about the number of households in the city of Cleveland Ohio

www.pjm.com

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



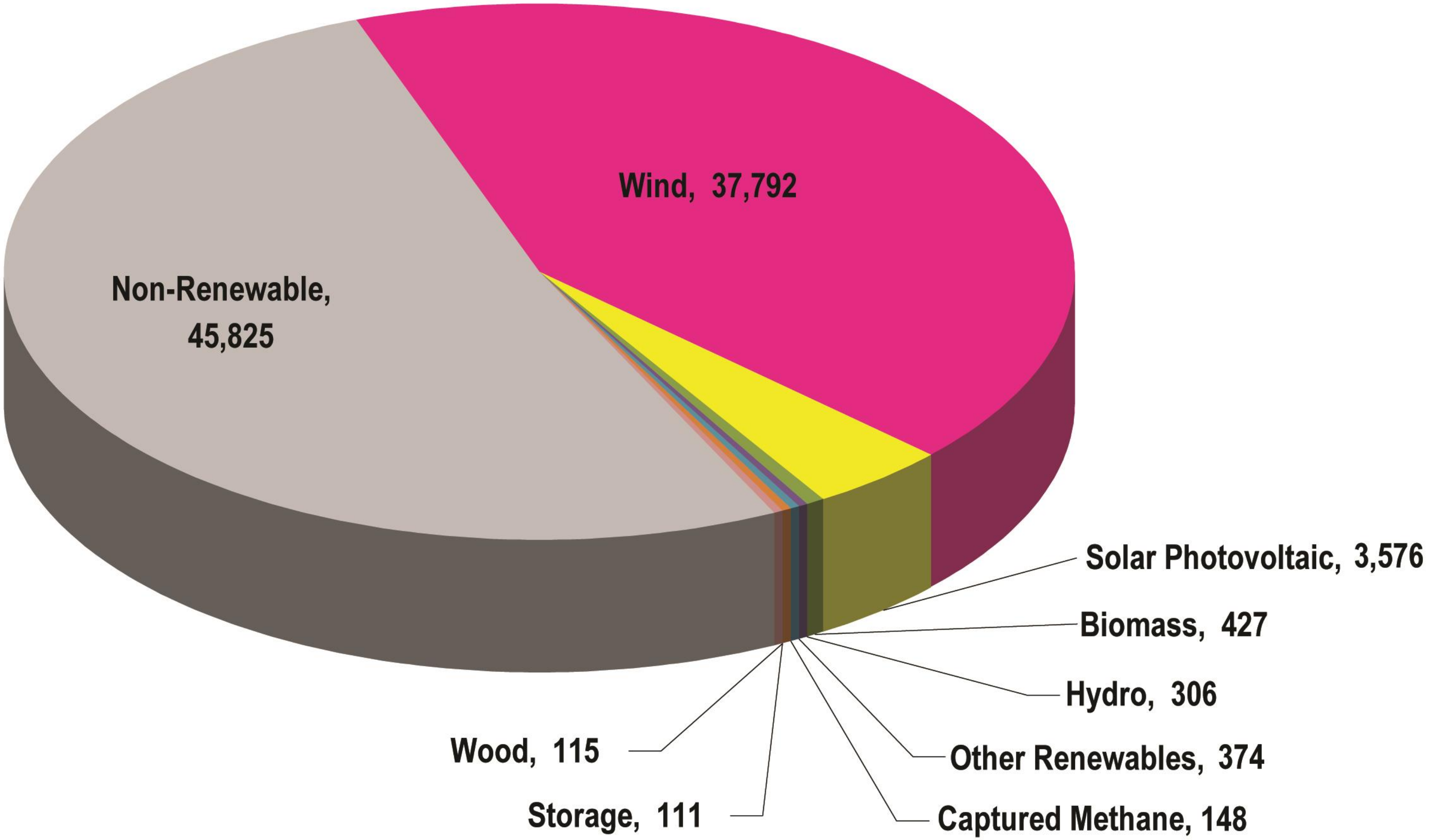
Installed Capacity in PJM (MW)



Wind Dependable Capacity = 649.5 MW/13%
Solar Dependable Capacity = 15.3 MW/38%

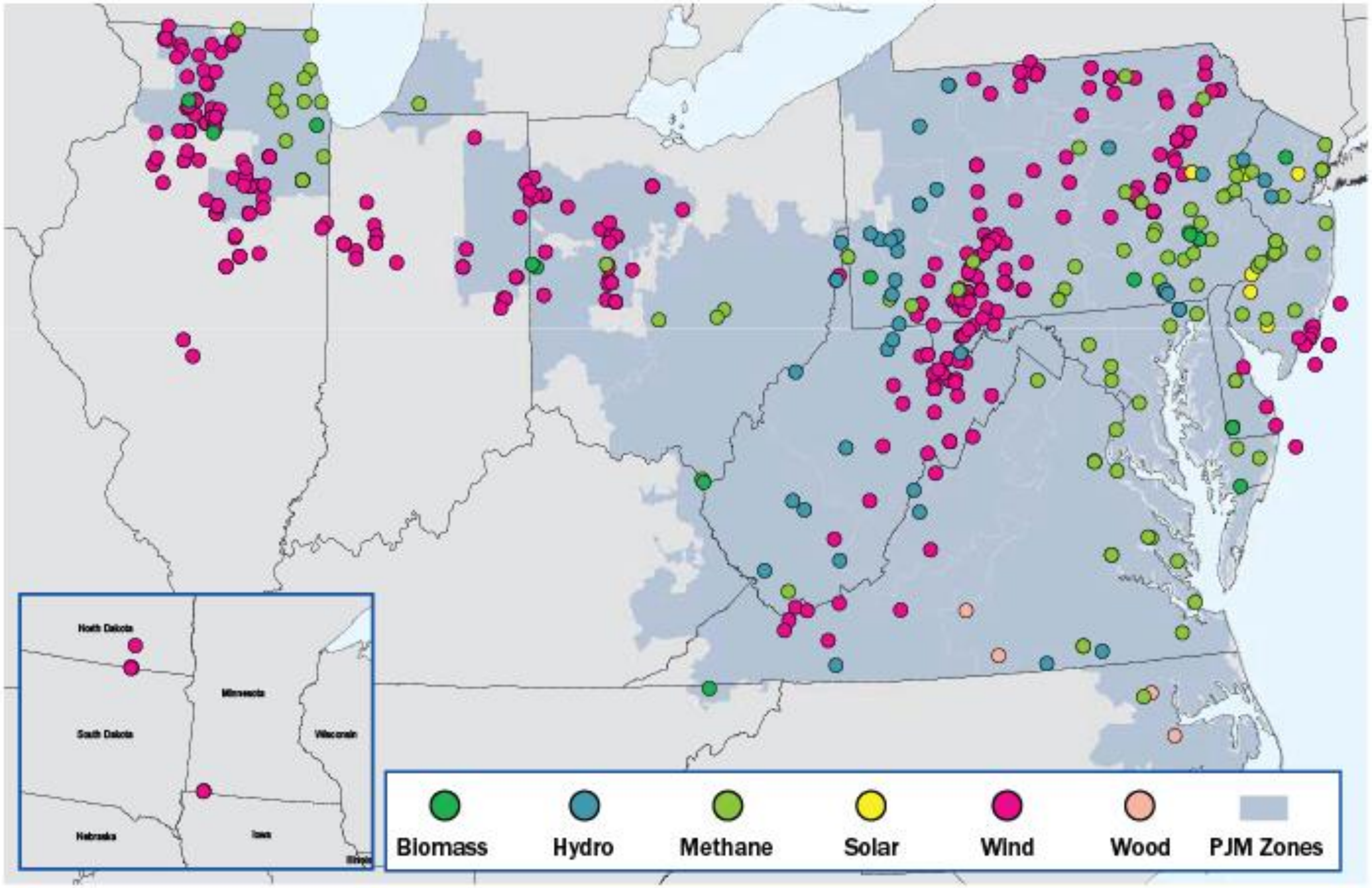
Source: Third Quarter 2011 State of Market Report

Proposed Generation (MW)



As of January 4, 2012

THE GOOD NEWS: ROBUST ACTIVITY IN THE RTO QUEUE
Proposed Renewable Generation in PJM



This map shows where renewable generation projects are proposed, including generation outside of PJM's footprint, which will trade in PJM's market.

POLICY CHOICES…

The Long and Winding Road…

- Transmission: Built to support major generation projects
- Connect distant generation to load; Distribution: One way delivery of power to the home
- Grid Costs: Rate-based to the home utility's customers
- ROI: Little focus on transmission as a stand alone business element

Policy Choice #1

Is the grid an enabler or a competitor?

Grid as an Enabler?

- –Accept the grid as a natural monopoly
- –Drive solutions through regulation
- –Provide incentives for innovation

Policy Choice #1 (cont'd)

Grid as a Competitor?

- Grid development must compete with generation or demand side
- Grid entrepreneurs take risk: no guaranteed ROI
- Grid pricing reflects competitive outcomes: Bid solutions into the marketplace (RPM)

Policy Choice #2: A Strong or Weak Grid?

Characteristics of the "Strong" Grid:

- Generation distance from load
- Meet the needs for future transmission expansion
- Costs socialized to reflect interconnected nature of the grid
- Broad regional approach

Policy Choice #2-The Alternative:

The localized grid…

- Generation closer to load
- Centralized focus on development of DSR, energy efficiency and renewables
- Transmission/distribution grid as an enabler of alternative generation
- Transmission focused on meeting state/local needs

Policy Choice #2: Decision Points

- Siting: Regional vs. Local Needs
- Cost Allocation: Socialization vs. Direct Assignment
- IRP/RPS vs. Competitive Procurement
- Short term procurement vs. long term

Policy Choice #3: Determine the Planning Philosophy

- Transmission decisions driven by generation investment or generation investment influenced by the planned transmission grid?
- Role of the Planning Authority

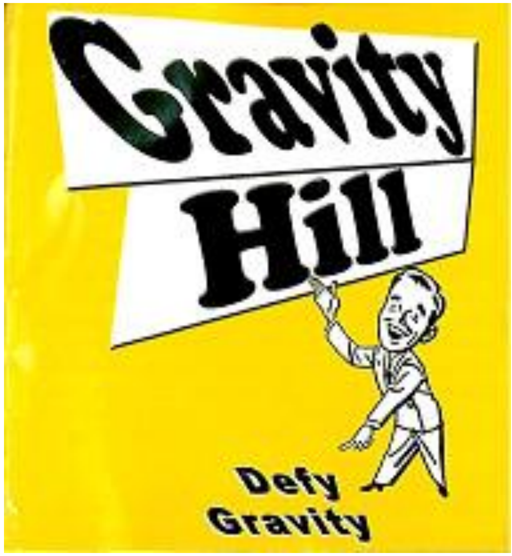
An Added Complication:

Who Decides?

Who Decides?

- States:
  - State Energy Policies: Governors/legislators
  - State PUCs
- FERC
  - FERC Review of Planning
    - Who chooses projects?
- Environmental Agencies
  - Non-attainment areas
  - RGGI et al.

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



The Task Ahead: Blocking, Tackling & Teamwork!

LET'S TALK…

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PJM Interconnection
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We Don't Need to Be 144 GW-Bold

HVDC + Utility Scale Wind as Part of the Right Resource Mix

Deral Danis
ddanis@cleanlineenergy.com

CLEAN LINE
ENERGY PARTNERS

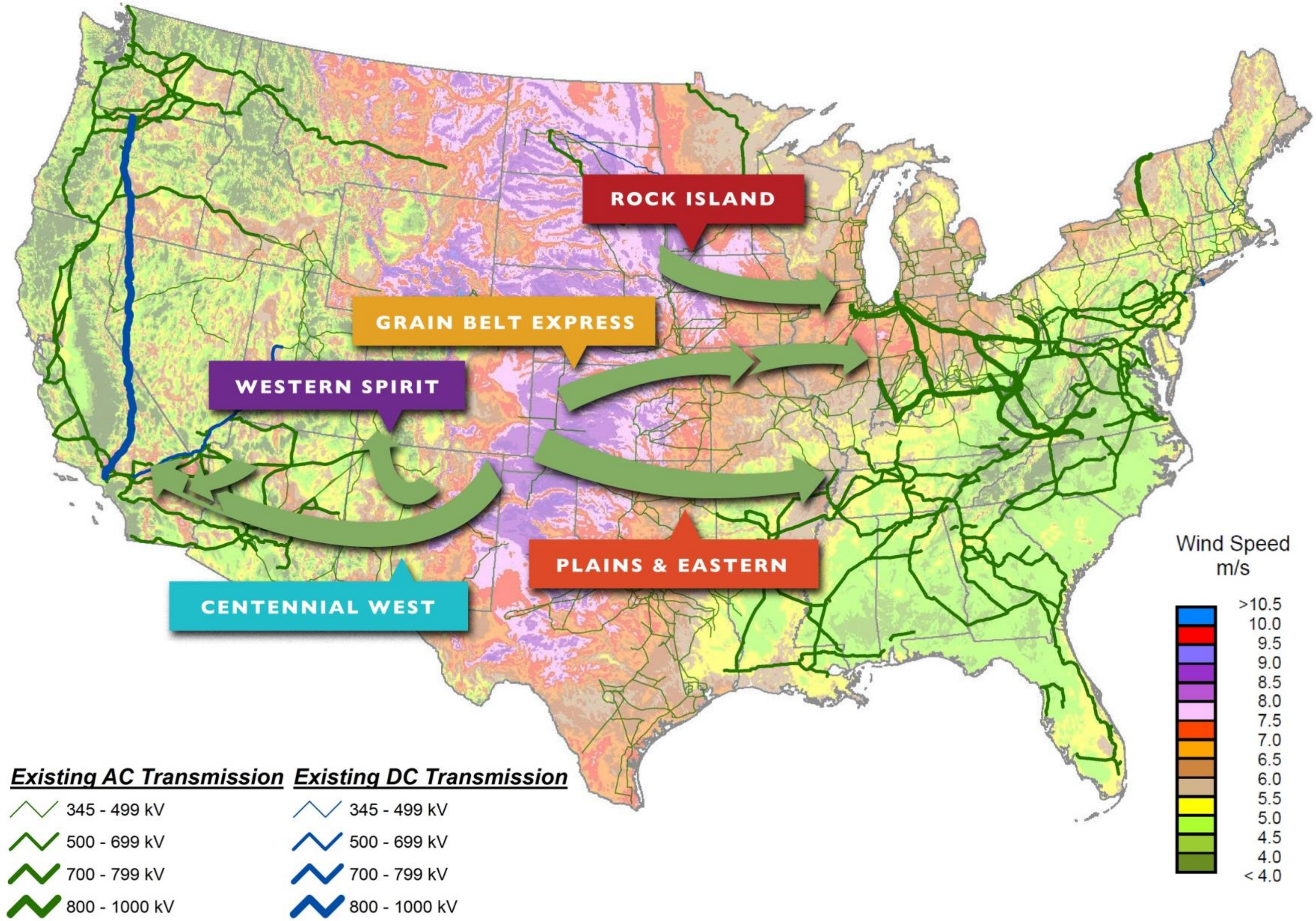
National Grid is a key investor in Clean Line Energy

nationalgrid

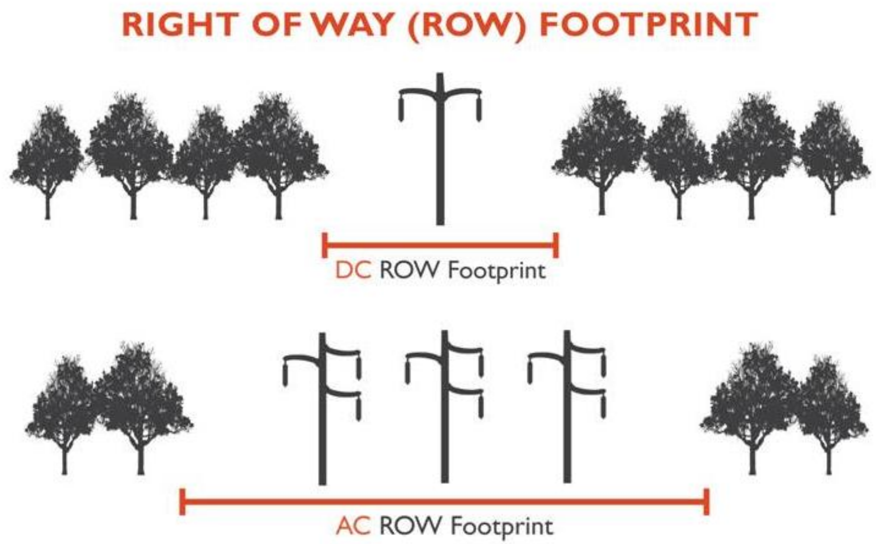
CLEAN LINE ENERGY PARTNERS

- National Grid brings extensive experience in building, owning, and operating large transmission projects in the United States and overseas
- National Grid owns and operates more than 8,600 miles of transmission in the United States
- National Grid joins Clean Line's existing investors that include private equity firm ZBI Ventures

Clean Line's projects connect the best wind resources to load centers



HVDC is the most efficient method to transmit large amounts of electricity over long distances



- **Improved reliability** — Control of power flow enhances system stability and lowers cost of integrating wind
- **More efficient** — Lower line losses
- **Lower cost** — Requires less infrastructure, results in lower costs and lower prices for delivered renewable energy
- **Direct connection to PJM**

Wind Production Correlation of Best Capacity Factor Sites Across Five States

Correlation of 10-Minute Wind Energy Generated

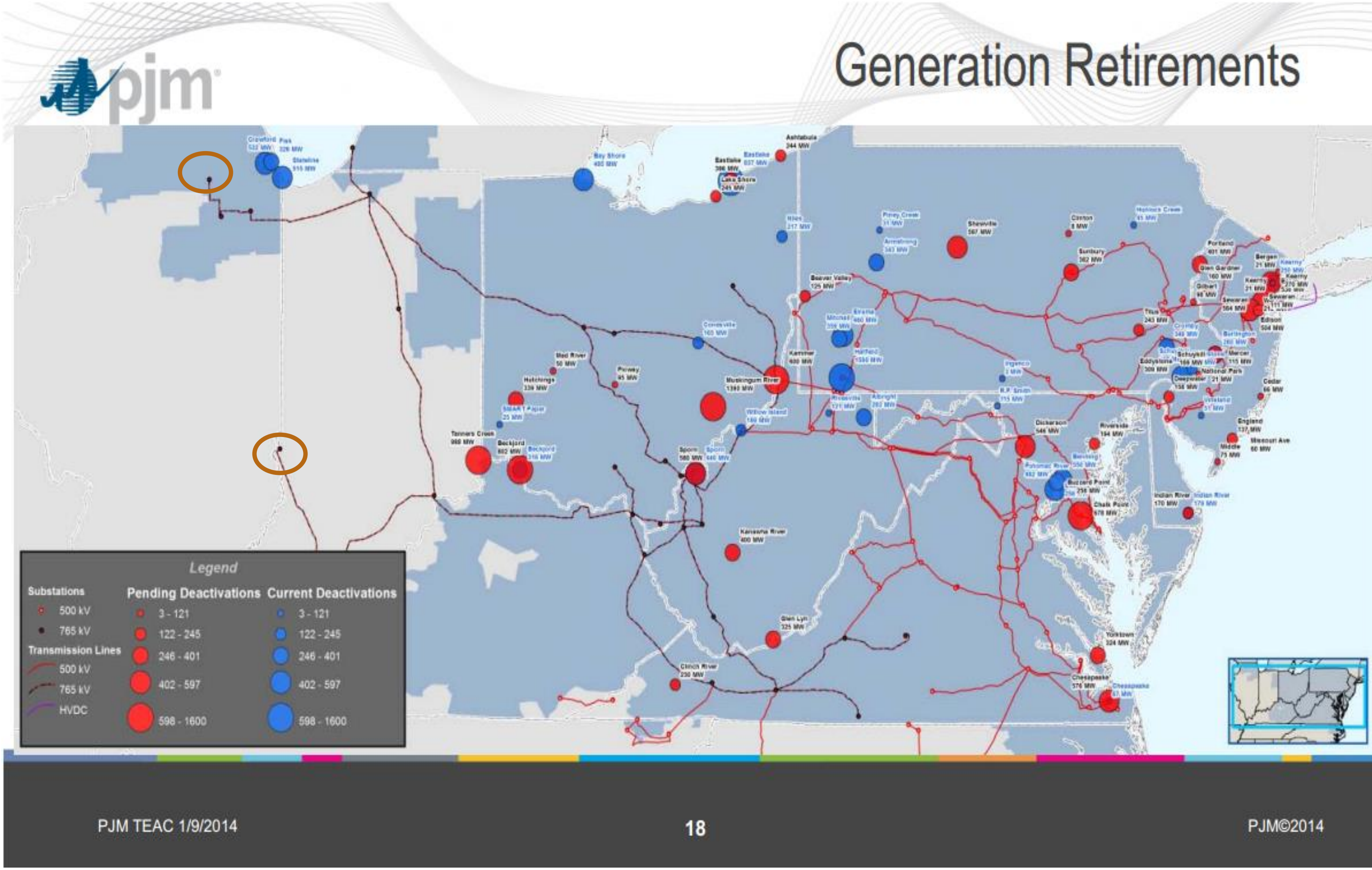
	KS	IA	IL	IN	PA
KS		0.37	0.09	0.03	.00
IA	0.37		0.19	0.07	.02
IL	0.09	0.19		0.75	.15
IN	0.03	0.07	0.75		.19
PA	.00	.02	.15	.19	

Low correlation
Medium correlation
High correlation

1. "Low correlation": between 0.0 and 0.25; "Medium correlation": between 0.25 and 0.5; "High correlation": between 0.5 and 1.0

Source: EWITS; Clean Line analysis

Rock Island and Grain Belt Express Interconnections

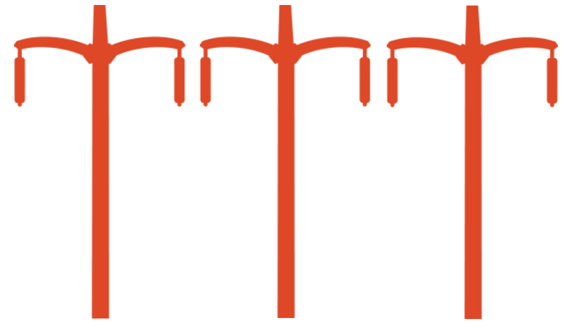


RFI responses indicate abundance of projects that need transmission to deliver wind energy to market

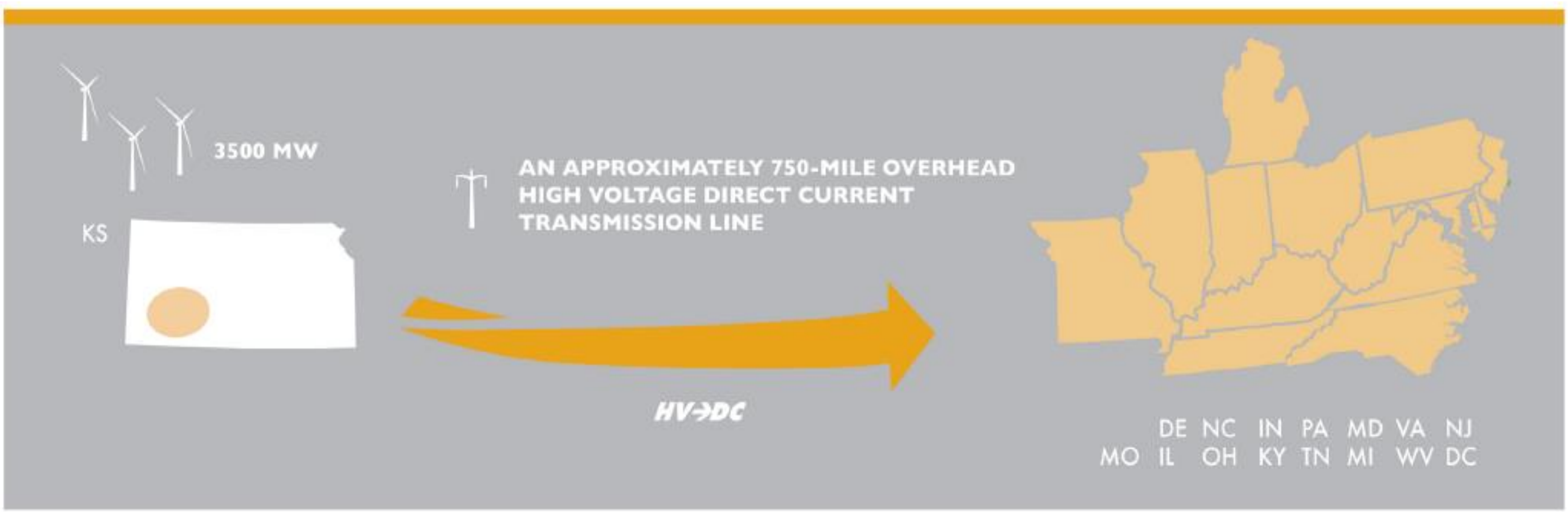
13,500+ MW

potential capacity

=

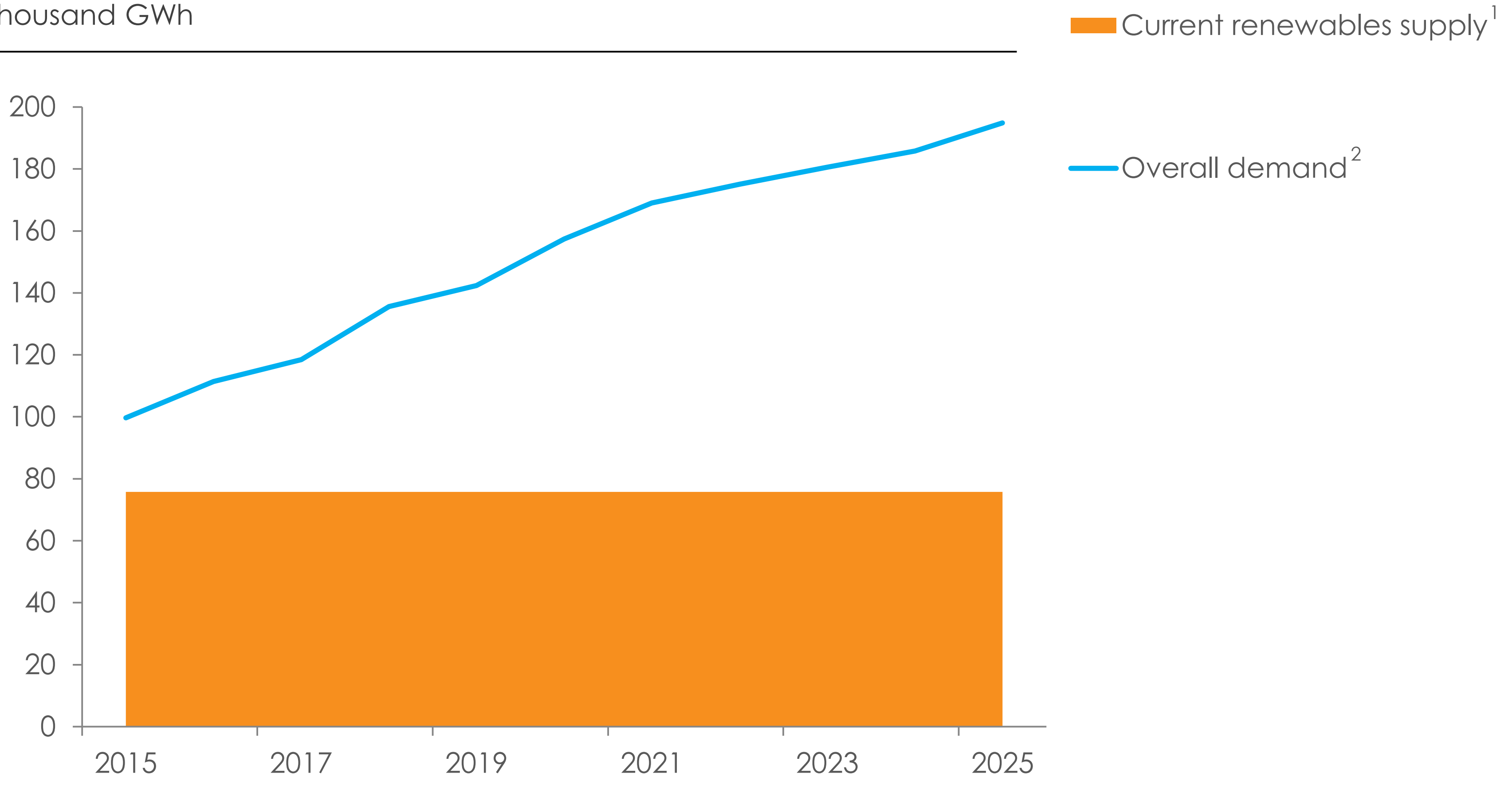


enough to fill Grain Belt Express 3+ times



RPS demand will drive major new wind installations, especially in the Eastern Interconnect

Renewable energy supply and demand in PJM and MISO states
Thousand GWh



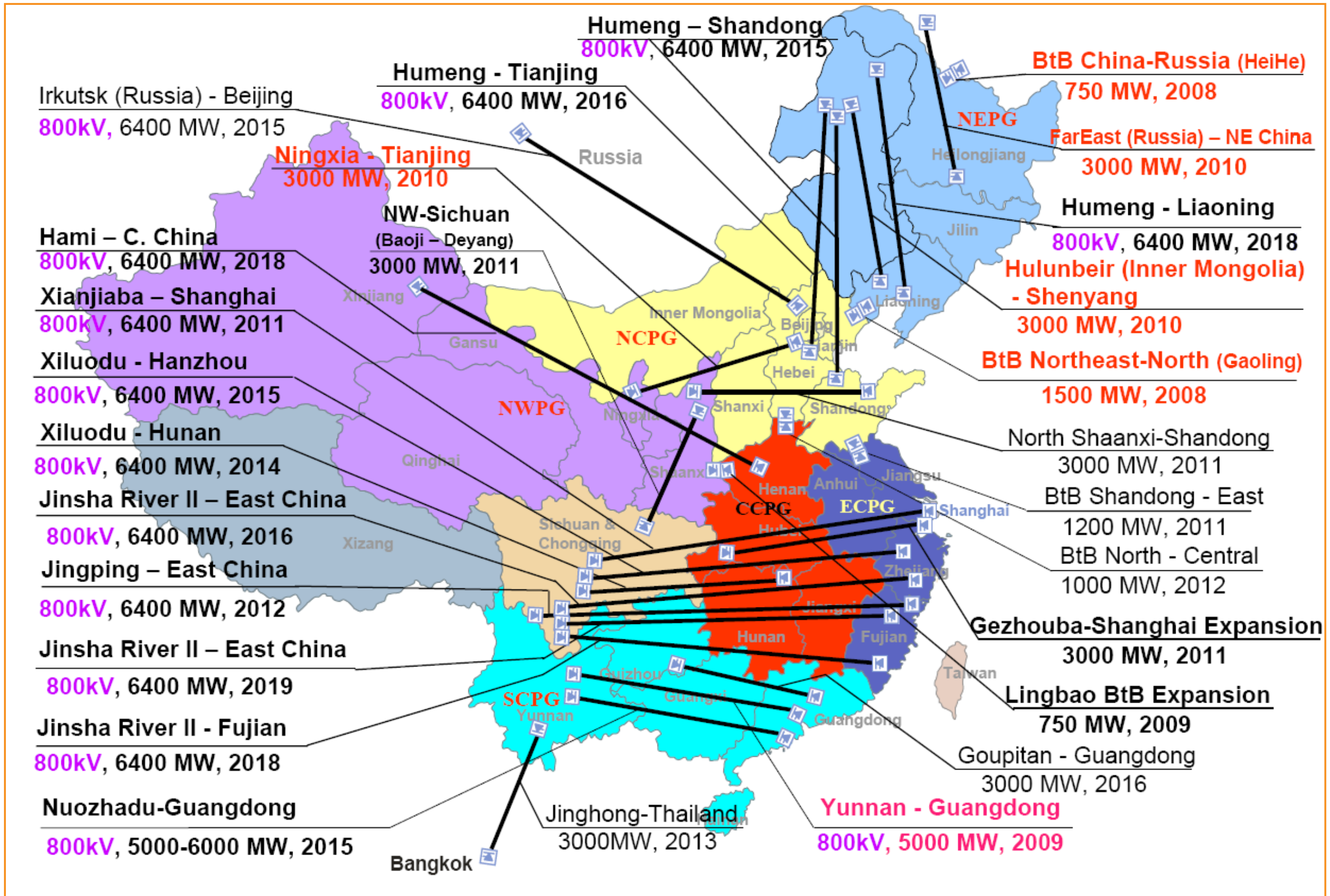
1. Energy from existing wind, biomass, and solar projects within the PJM and MISO states
2. Demand for renewable energy credits within PJM and MISO. States with voluntary goals are not included in the demand calculations.

Source: EIA; DSIRE; AWEA

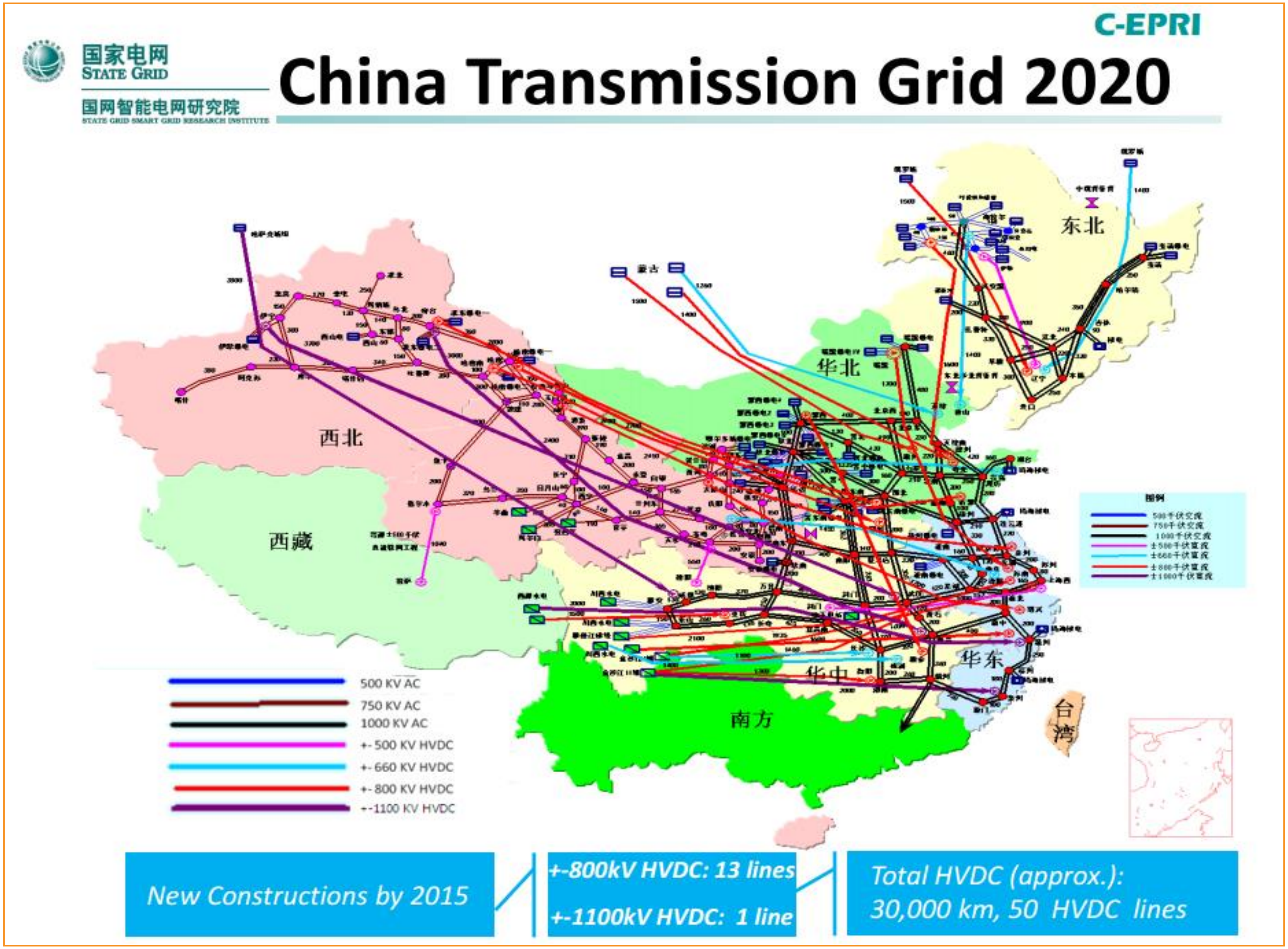
An HVDC Renaissance

Power Engineering INTERNATIONAL
Power generation news, technology and trends for Europe, Asia, South America, Africa and Oceania

June 2013: “China takes HVDC to new level”



88.6GW to be added to the existing 55.2GW by 2015
That's a BOLD 144 GW



CLEAN LINE

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ENABLING A HIGHLY RENEWABLE ELECTRICITY SYSTEM

LENA HANSEN

24 JANUARY 2014

ROCKY MOUNTAIN INSTITUTE®

ABOUT RMI AND ELAB

ROCKY MOUNTAIN INSTITUTE®

Rocky Mountain Institute works across industries on challenging energy issues to drive the efficient and restorative use of resources with market-based approaches

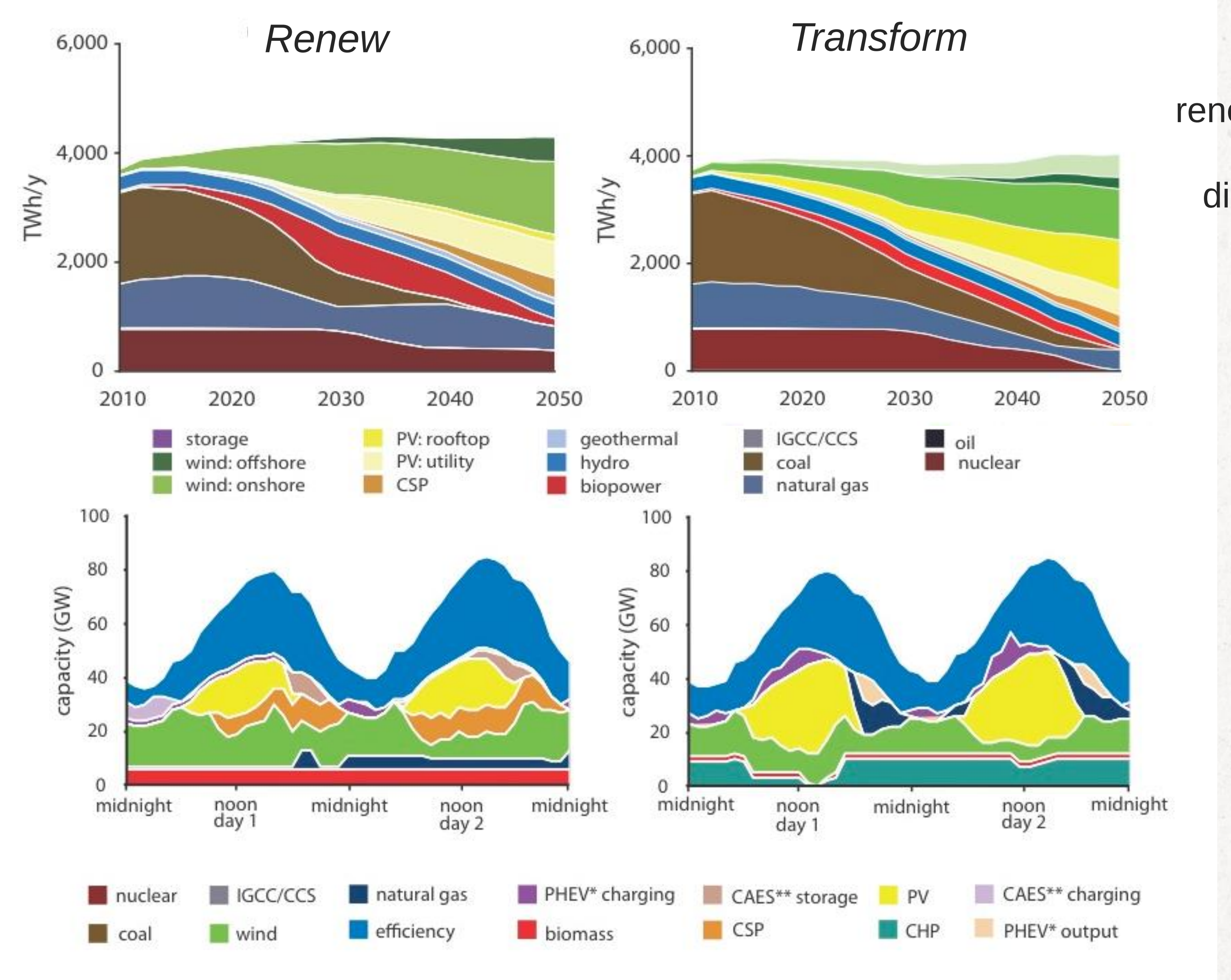
e⁻Lab
Electricity Innovation Lab
ROCKY MOUNTAIN INSTITUTE

e-Lab brings together leading electricity sector actors to solve regulatory, business, and economic barriers to the economic deployment of distributed resources

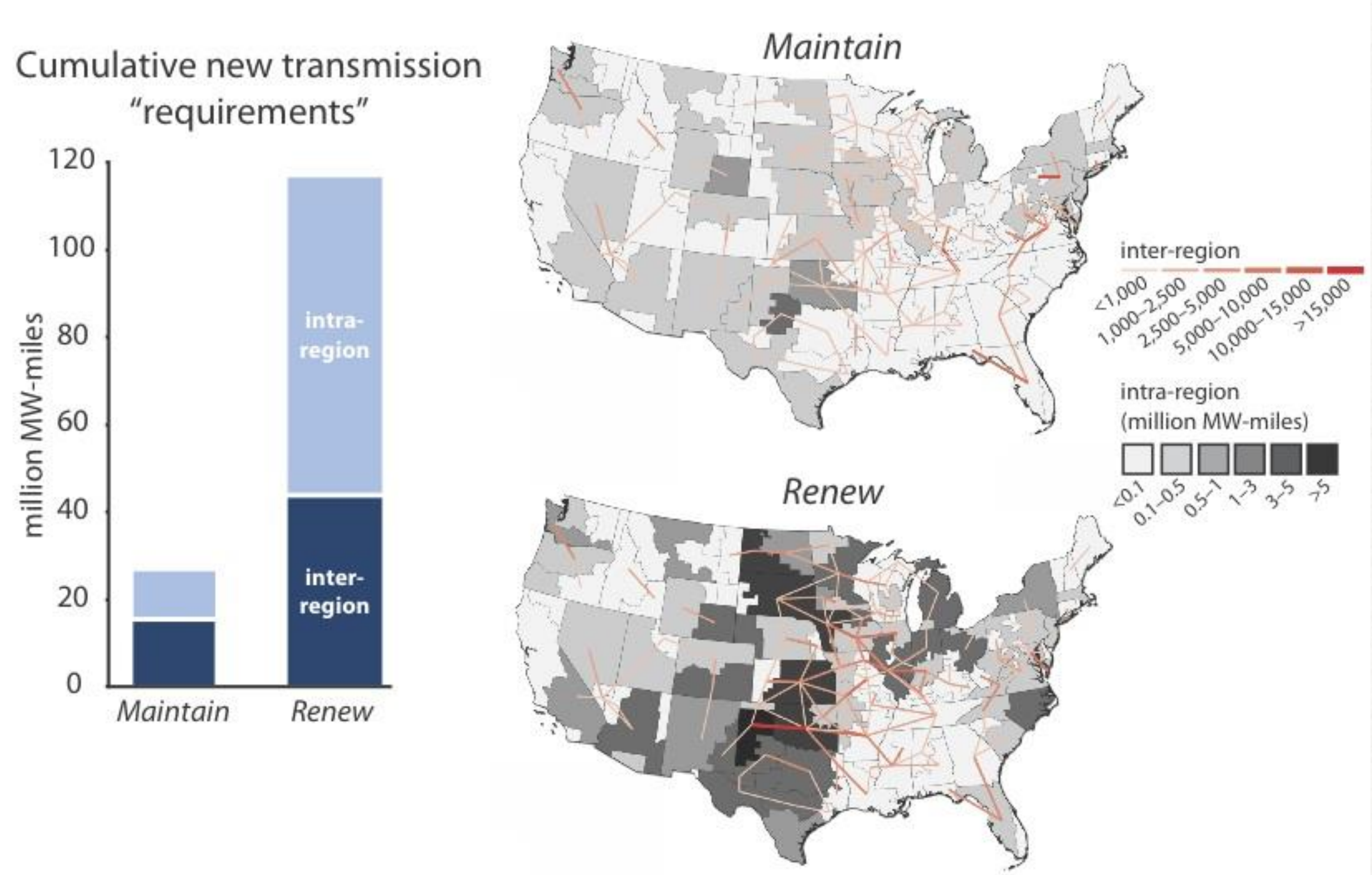
REINVENTING FIRE'S 2 HIGH-RENEWABLE SCENARIOS

80% renewables, largely centralized

80% renewables, 50% distributed



NOT SURPRISINGLY, MORE TRANSMISSION NEEDED IN *RENEW* COMPARED TO *MAINTAIN* BASE CASE



ROLE FOR DISTRIBUTED RESOURCES IN ALLEVIATING TRANSMISSION NEEDS?

- Other studies have similar findings
  - NREL's Renewable Electricity Futures Study identified an incremental transmission investment of $97B nationally from 2011-2050
  - PJM Renewable Integration Study also calls for more transmission—critical to access best renewables and facilitate operations by better linking balancing areas

- These studies all focused on centralized renewables

- Important question – what is the optimal balance of centralized and distributed resources, and what are the implications on transmission needs?

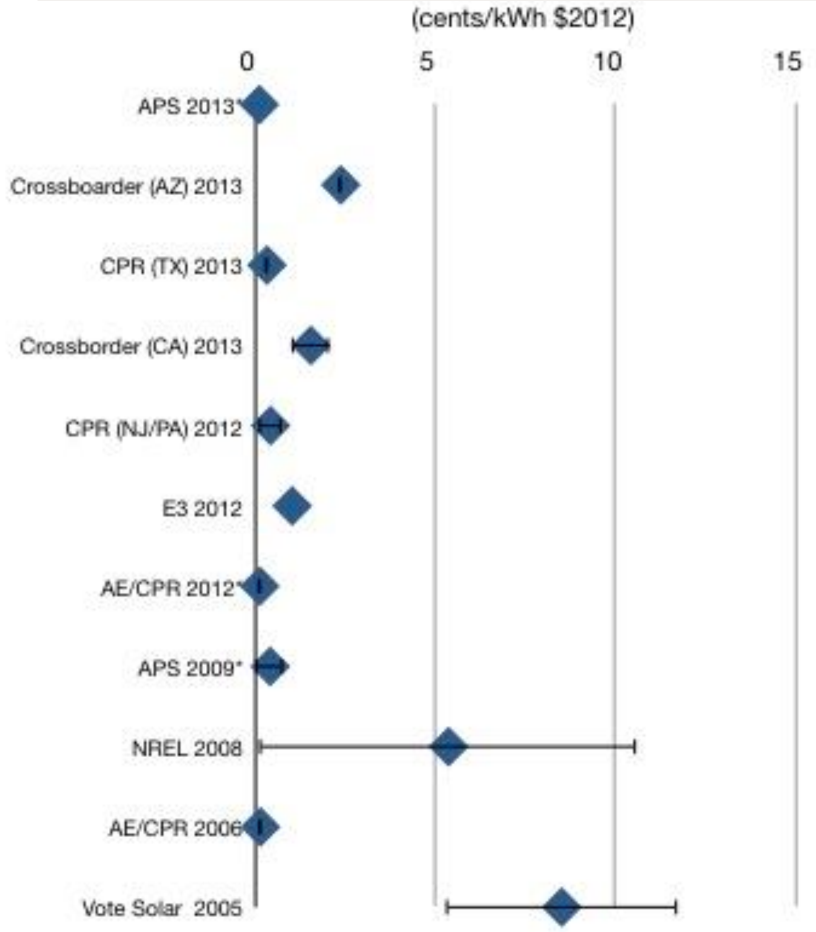
A FEW THOUGHTS ON DISTRIBUTED RESOURCES

National transmission investment estimates

	REFS	*Renew*	*Transform*
Transmission investment (2011-2050, $B, $2009)	$98	$60	$54

- Efficiency is key
- Increasing levels of distributed resources likely from customer choice—need to minimize overbuilding
- Value can include energy, generation & grid capacity, and ancillary services

Distributed solar T&D capacity benefit estimates



HIGHLIGHTS: DISTRIBUTED RESOURCES IN PJM

- 14,000 MW of **demand response** and energy efficiency have cleared in forward capacity market auctions in past 5 years—by far largest share of new resources

- Significant **fuel cell** deployment, ~ 30 MW

- **eV2g** pilot project actively participating in PJM's frequency response market, which necessitated new rules around minimum size and value for performance

LOOKING AHEAD—KEY ENABLERS TO LEVERAGING VALUE FROM DISTRIBUTED RESOURCES (DERS)

- Build better understanding of how DERs can alleviate transmission congestion
- Increase transparency into the distribution system—shift to more detailed information on where DERs *are*
- Assess need for more stringent operating parameters to optimize resource use and reduce costs
- Improve DER forecasting capability and find solution to uncertainty issue—integrate more fully into planning
- Continue to drive toward more level playing field for NTAs

Rocky Mountain Institute®

Creating a clean, prosperous, and secure energy future™

Sustainable FERC Project

Policies for a Clean Electric Grid





NRDC
THE EARTH'S BEST DEFENSE

WHAT IS THE SUSTAINABLE FERC PROJECT?

NGO COALITION

- Founded in 1996
- Housed in NRDC

- Renewable energy
- Demand response
- Distributed generation
- Energy efficiency

REPRESENTS ENVIRONMENTAL COMMUNITY VIEWS AT:

FERC • RTOs • ISOs • REGIONAL TRANSMISSION PLANNING PROCESSES

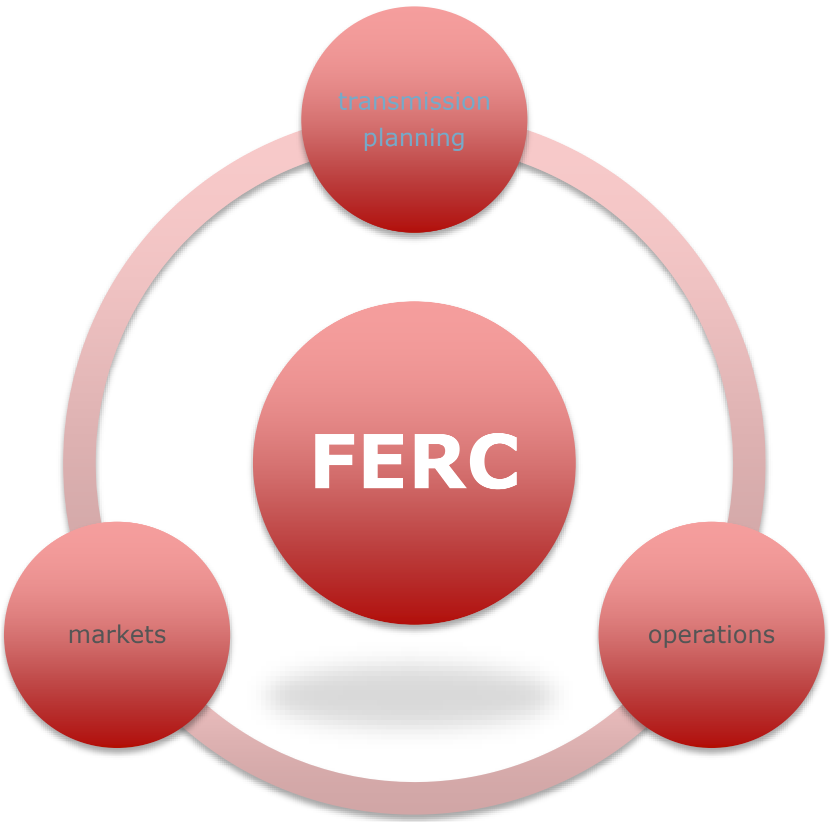
WHO IS THE SUSTAINABLE FERC PROJECT?

JOHN

ALLISON

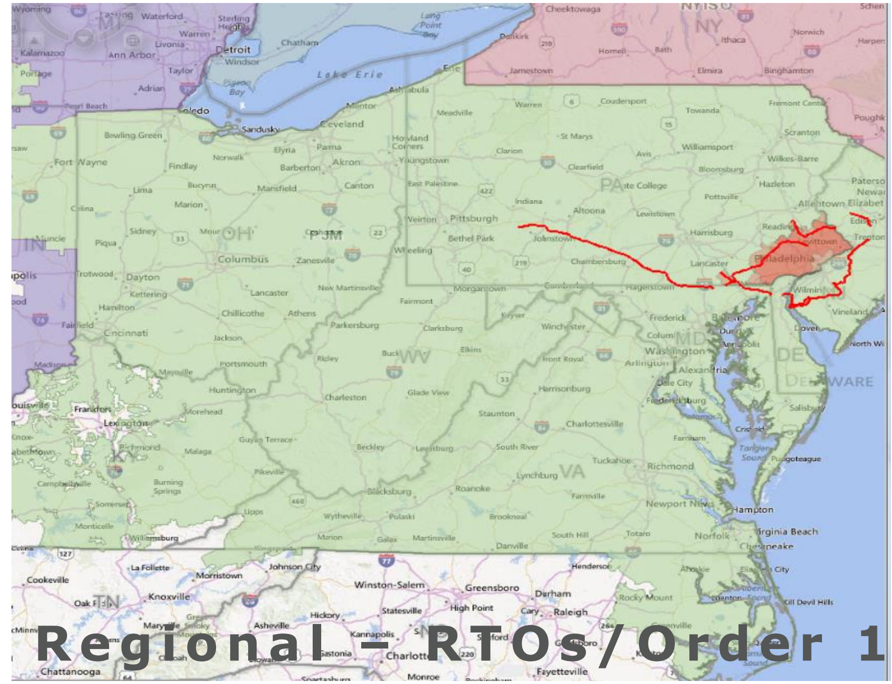
IS PJM PLANNING FOR A LOW CARBON FUTURE?

DEPLOYING RENEWABLES, DISTRIBUTED GENERATION AND ENERGY EFFICIENCY

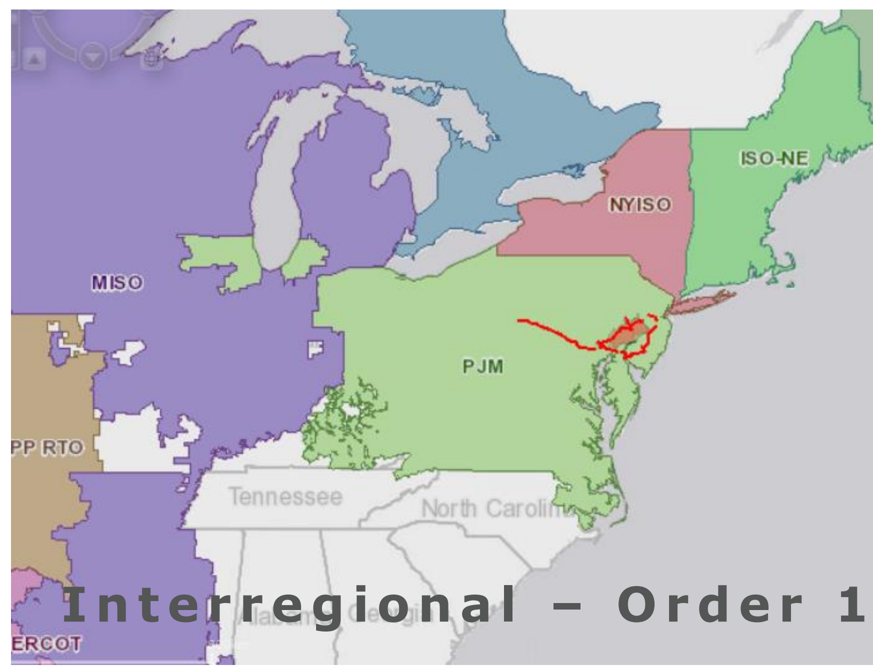


WHAT DOES PLANNING REQUIRE?

Local – Order 890



Regional – RTOs/Order 10



Interregional – Order 10

PJM – PLANNING FOR RENEWABLES?

- The PJM system, with additional reserves and transmission build-out, could handle renewable penetration levels up to 30%.
- The principal impacts of higher penetration of renewable energy into the grid include:
  - Lower Coal and CCGT generation under all scenarios
  - Lower emissions of criteria pollutants and greenhouse gases
  - No loss of load and minimal renewable energy curtailment
  - Lower system-wide production costs
  - Lower generator gross revenues
  - Lower average LMP and zonal prices

PJM – PLANNING FOR RENEWABLES?

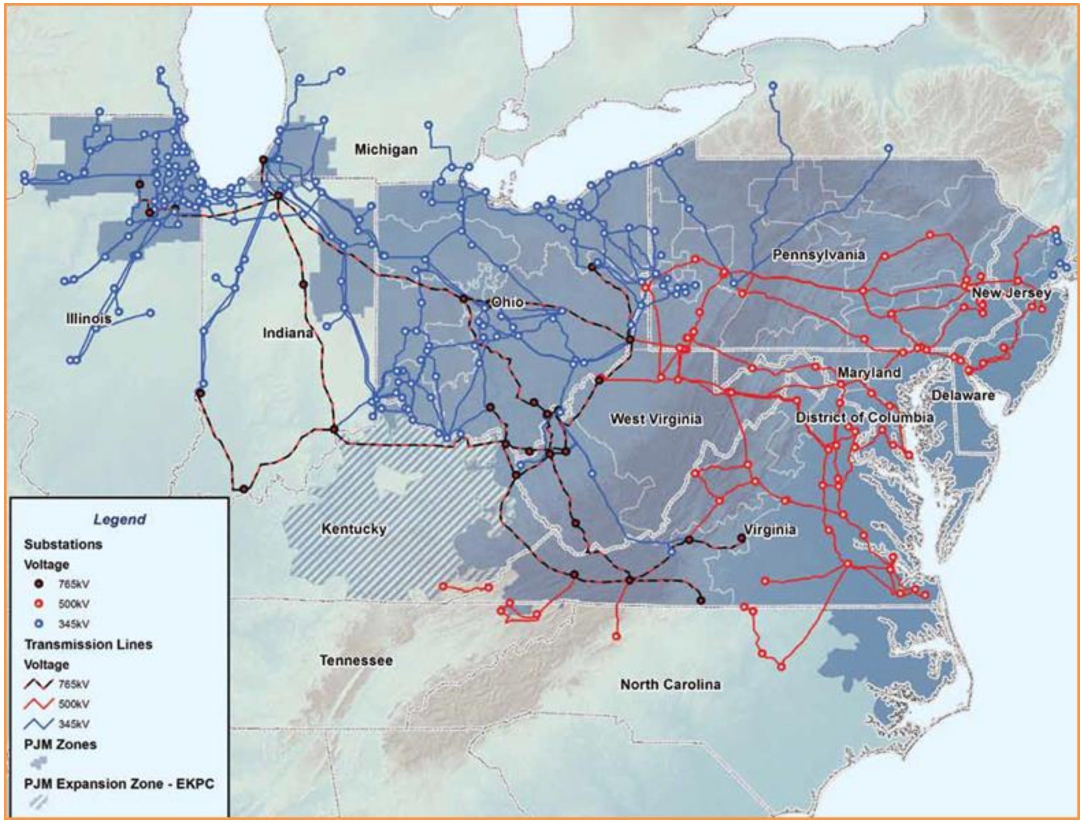
ORDER 1000

-public policy consideration

-cost allocation

MULTI-DRIVER APPROACH

RPS PLANNING STUDIES



PLANNING FOR A LOW-CARBON FUTURE: RECOMMENDATIONS

PLAN **FOR PUBLIC POLICIES**

INCREASE STATE ENGAGEMENT ON PLANNING/COSTS OVER TIME

PLAN FOR RE INTEGRATION STUDY RESULTS

INSURE MARKETS-PLANNING COORDINATION

PROVIDE COMPARABLE TREATMENT FOR NTAs

Questions?

THANK YOU FOR JOINING US

- Please visit our site at www.cleanenergytransmission.org
- Follow us on Twitter @clean_energy_grid
- Join us for future webinars and events, and feel to reach out to us for any transmission-related questions.

Americans for a Clean Energy Grid

energy future COALITION