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National Association of Regulatory Utility Commissioners

Regional Transmission Organizations (RTOs)

Commissioner Joanne Doddy Fort
Public Service Commission of the District of Columbia
October 22, 2014

PRESENTATION OVERVIEW

- What are Regional Transmission Organizations (RTOs) and how do they function?
- How do State Utility Commissions interact with RTOs?
- What is the Eastern Interconnection States' Planning Council (EISPC) and how does it function?

WHAT IS A RTO?

"An entity that is independent from all generation and power marking interests and has exclusive responsibility for grid operations, short-term reliability and transmission service within the region."

FERC definition in FERC Order 2000

http://www.ferc.gov/legal/maj-ord-reg/land-docs/RM99-2A.pdf

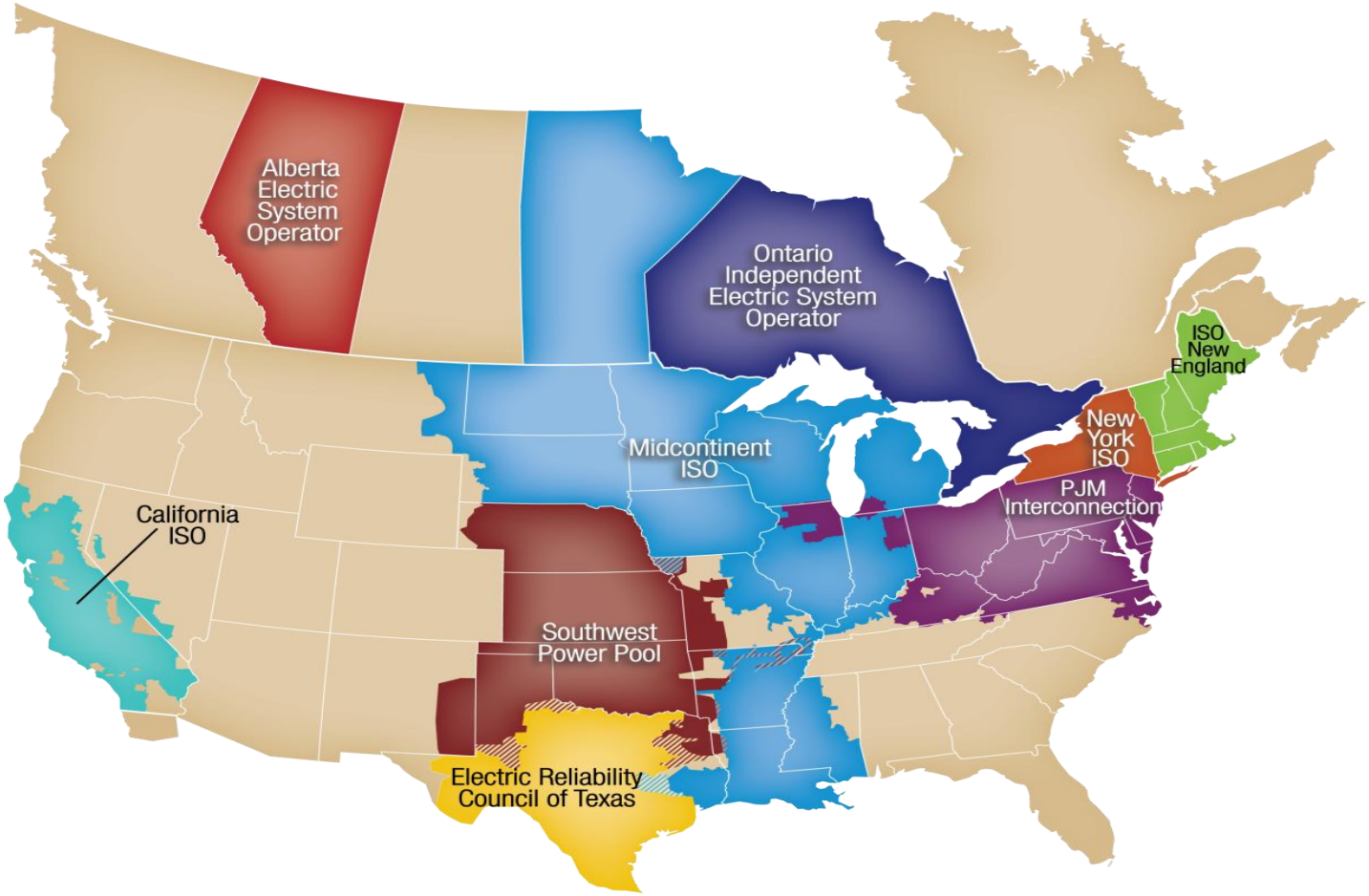
KEY FERC ORDERS FOR RTOS

- FERC Orders 888/889 (1996)
  - Establishes a *pro forma* open access transmission tariff (OATT), and set guidelines for Independent System Operators(ISOs)
- FERC Order 2000 (1999)
  - Establishes Regional Transmission Organizations and their operating framework.
- FERC Order 890 (2007)
  - Sets out guidelines for Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities
- FERC Order 1000 (2011)
  - Sets out guidelines for Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities

CHARACTERISTICS AND FUNCTIONS OF RTOs

- Minimum Characteristics required by FERC Order 2000
  - Independence
  - Scope and Regional Configuration
  - Operational Authority
  - Short-term Reliability
- Minimum Functions by FERC Order 2000
  - Tariff administration and design
  - Congestion management
  - Parallel path flow
  - Ancillary services
  - Open Access Same-Time Information System (OASIS)
  - Market monitoring
  - Planning and expansion
  - Interregional Coordination

FERC RTOs AND ISOs



WHO ARE THE PLAYERS IN A RTO?

Internal RTO Players:

- Independent Board of Managers
- Members
  - Generator Owners
  - Transmission Owners
  - Other Suppliers
  - Electric Distributors
  - End-Use Customers
- Independent Market Monitor (IMM) or Market Monitoring Unit (MMU)

WHO ARE THE PLAYERS IN A RTO?

External RTO Players:

- Transmission Owners
- Market Participants
- Other RTO Customers
- End-use consumers
- Stakeholders
- State and local officials

HOW ARE RTOs GOVERNED?

Basic Governing Documents

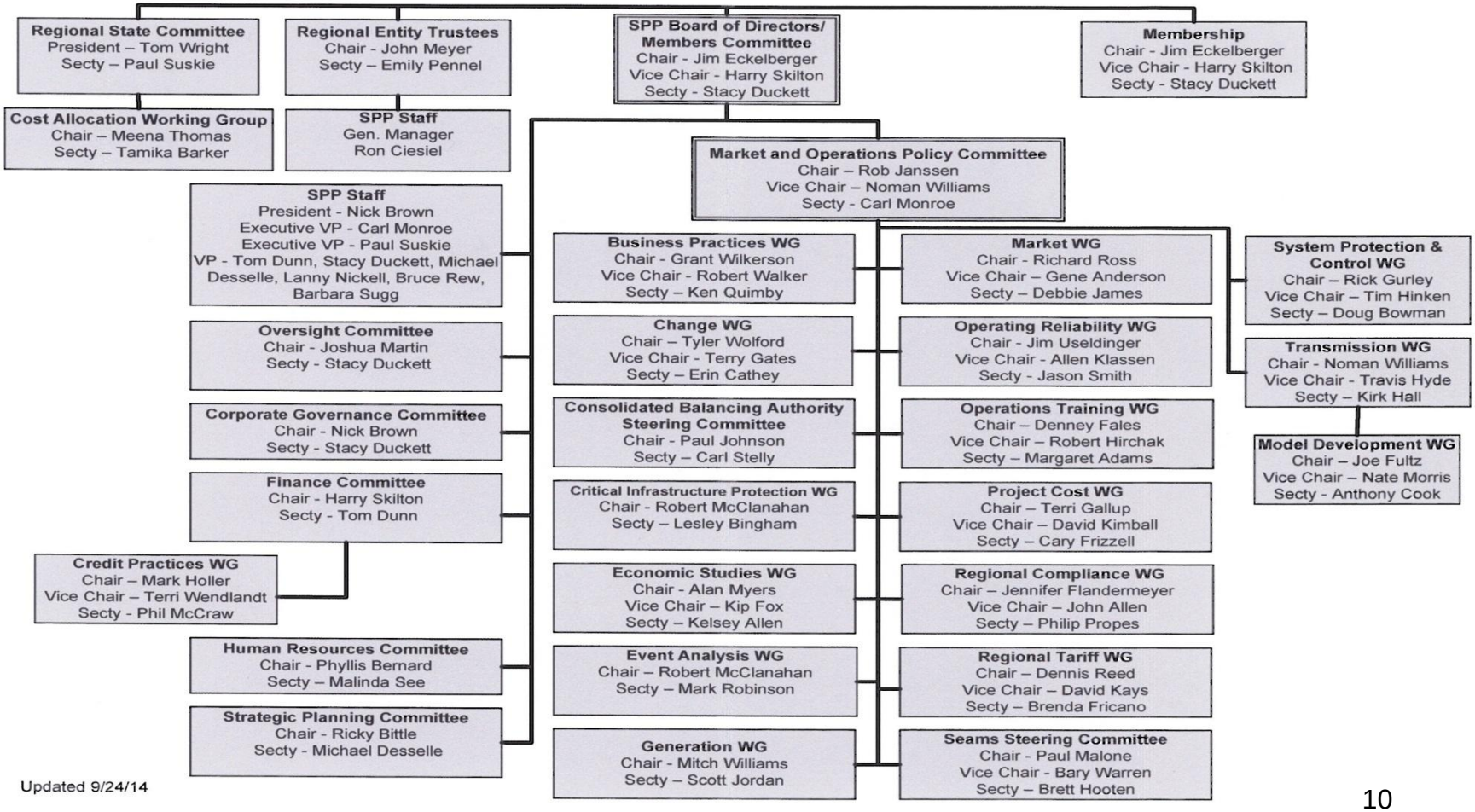
- Open Access Transmission Tariff (OATT)
- Operating Agreements
- Transmission Owners Agreement
- Reliability Assurance Agreement
- Joint Operating Agreements (JOA)

Market Manuals

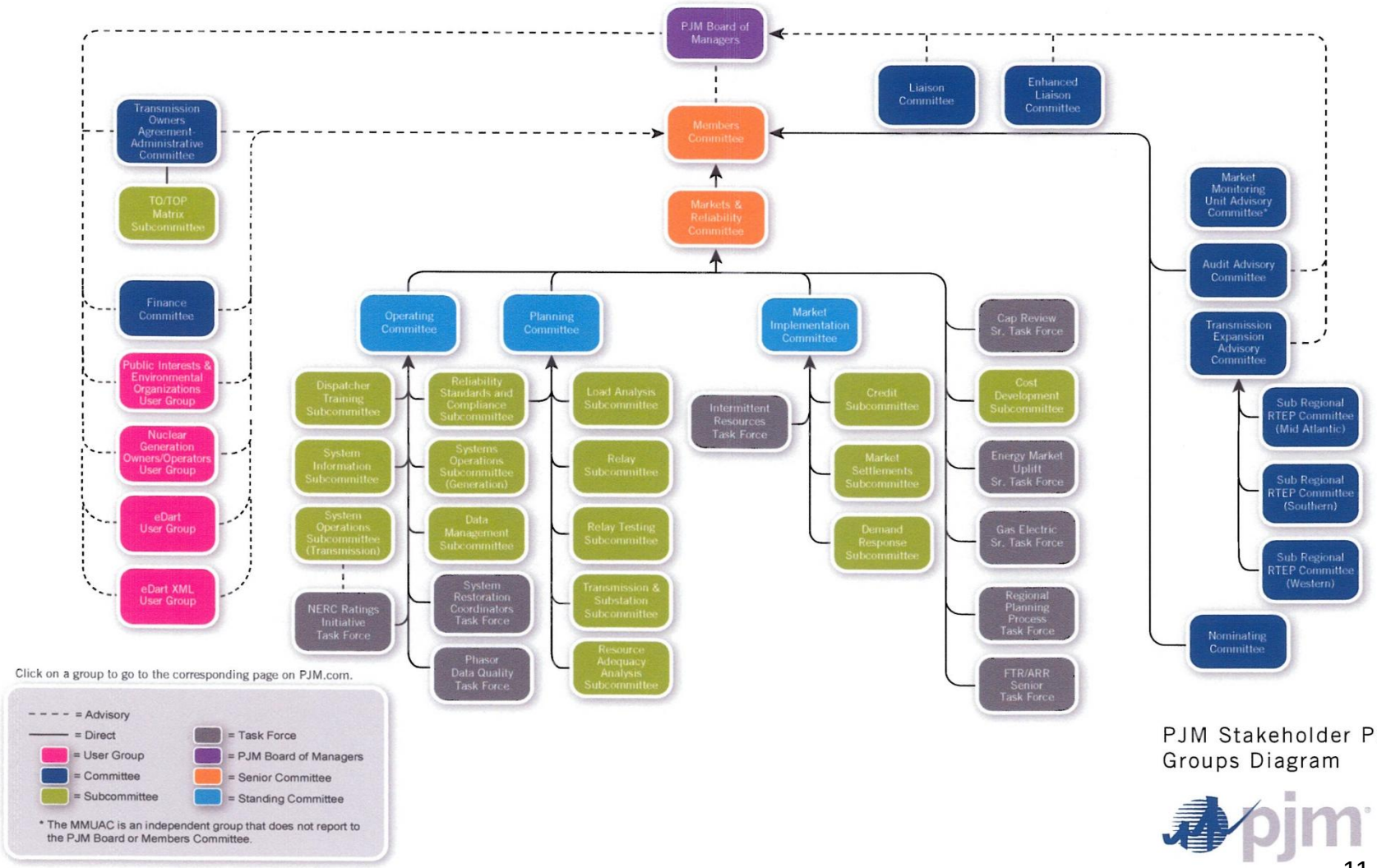
Stakeholder Process

SPP Southwest Power Pool

Group Organizational Chart



Updated 9/24/14



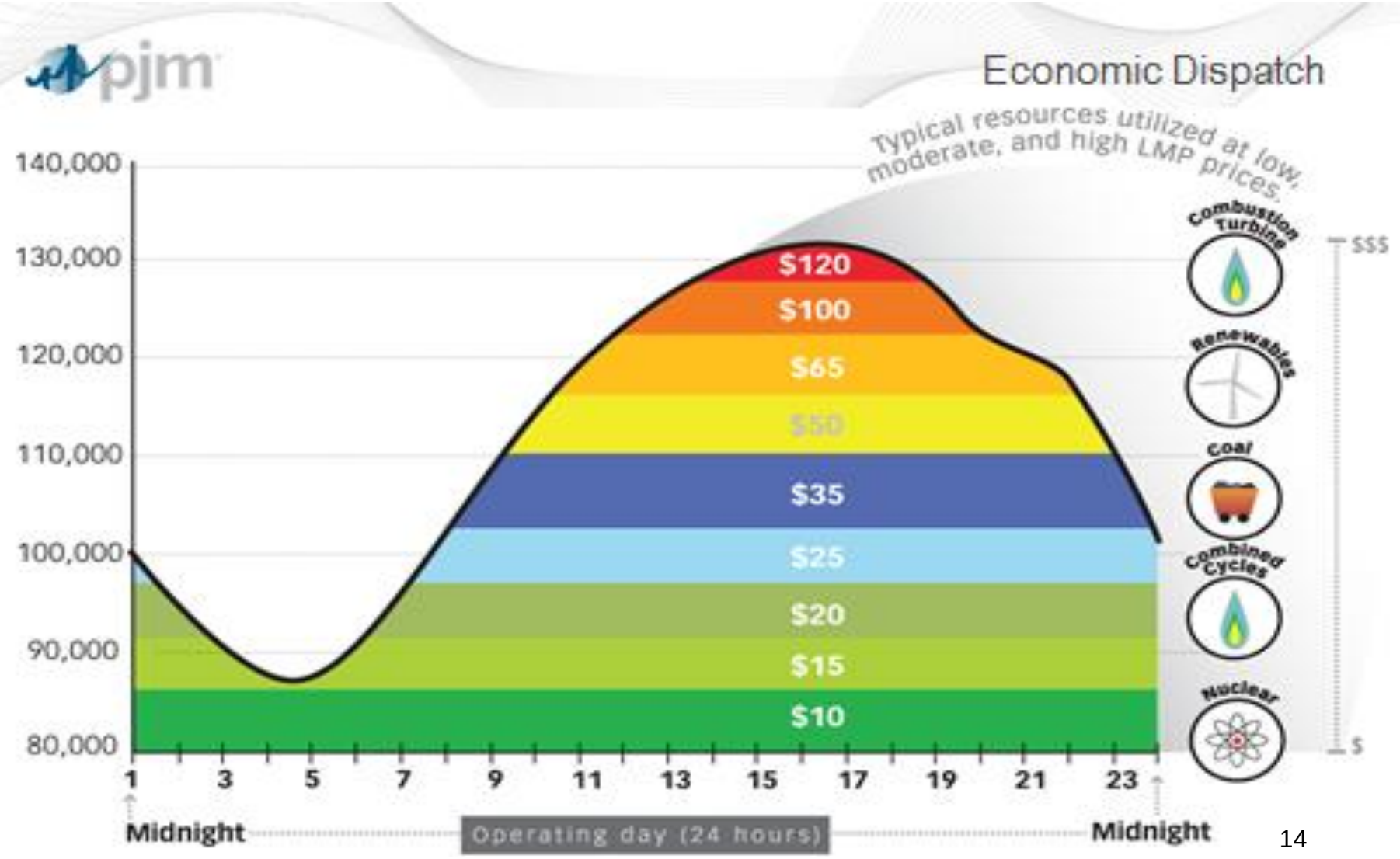
PJM Stakeholder Process Groups Diagram

WHAT IS THE KEY FOCUS OF AN RTO?

- Maintaining and enhancing electric grid reliability
  - Grid Operations
  - Supply/Demand Balance
  - Transmission monitoring and security
- Operating open, fair and competitive wholesale energy market
  - Energy Market: Day-Ahead, Real-Time & Ancillary Services, Financial Transmission Rights (FTR) and Capacity (RPM)
- Regional Transmission Planning
  - Reliability and economic planning
  - Transmission studies

HOW DO RTO ENERGY MARKETS WORK?

- Participants purchase and sell energy at binding Day-Ahead Locational Marginal Prices(LMP)
- Locational Marginal Pricing (LMP) is calculated: System Energy Price+Congestion Price+ Loss Price
- Economic dispatch selects and uses the least expensive resource first to meet energy demand
- When demand increases, more expensive generators are dispatched, raising the Locational Marginal Price
- System recognizes and dispatches generation to control for constraint conditions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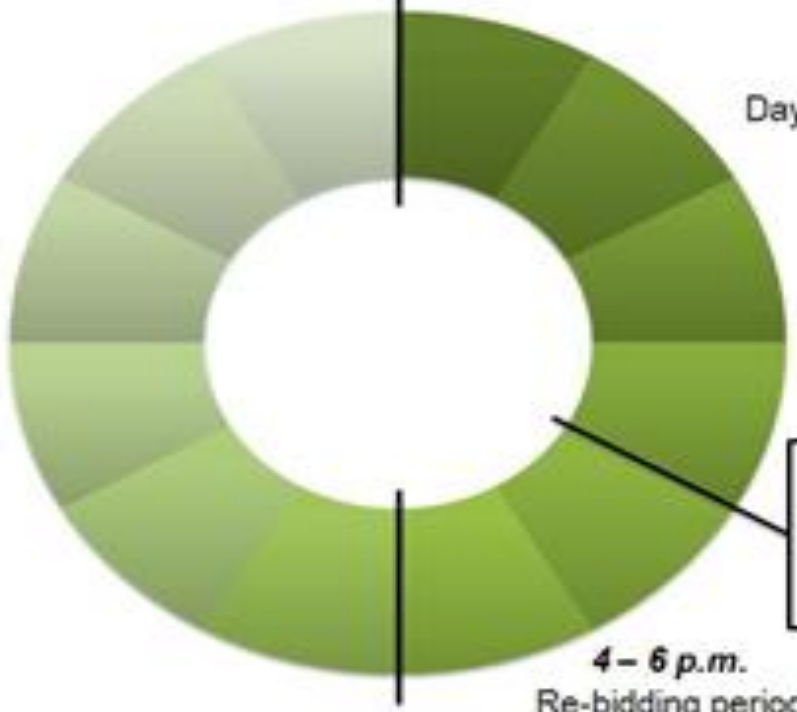
Economic Dispatch
Typical resources utilized at low, moderate, and high LMP prices.
140,000
130,000
120,000
110,000
100,000
90,000
80,000
$120
$100
$65
$50
$35
$25
$20
$15
$10
Combustion Turbine
Renewables
Coal
Combined Cycles
Nuclear
$$$
$
1
3
5
7
9
11
13
15
17
19
21
23
Midnight
Operating day (24 hours)
Midnight

Market Timeline

Day-Ahead Market Timeline



Up to 12:00 noon
PJM receives bids and offers for the next Operating Day

Noon – 4 p.m.
Day-Ahead market is closed for evaluation by PJM

Throughout Operating Day
PJM continually re-evaluates & sends out individual generation schedule updates, as required

4 p.m.
PJM posts Day-Ahead LMPs and hourly schedules

4 – 6 p.m.
Re-bidding period

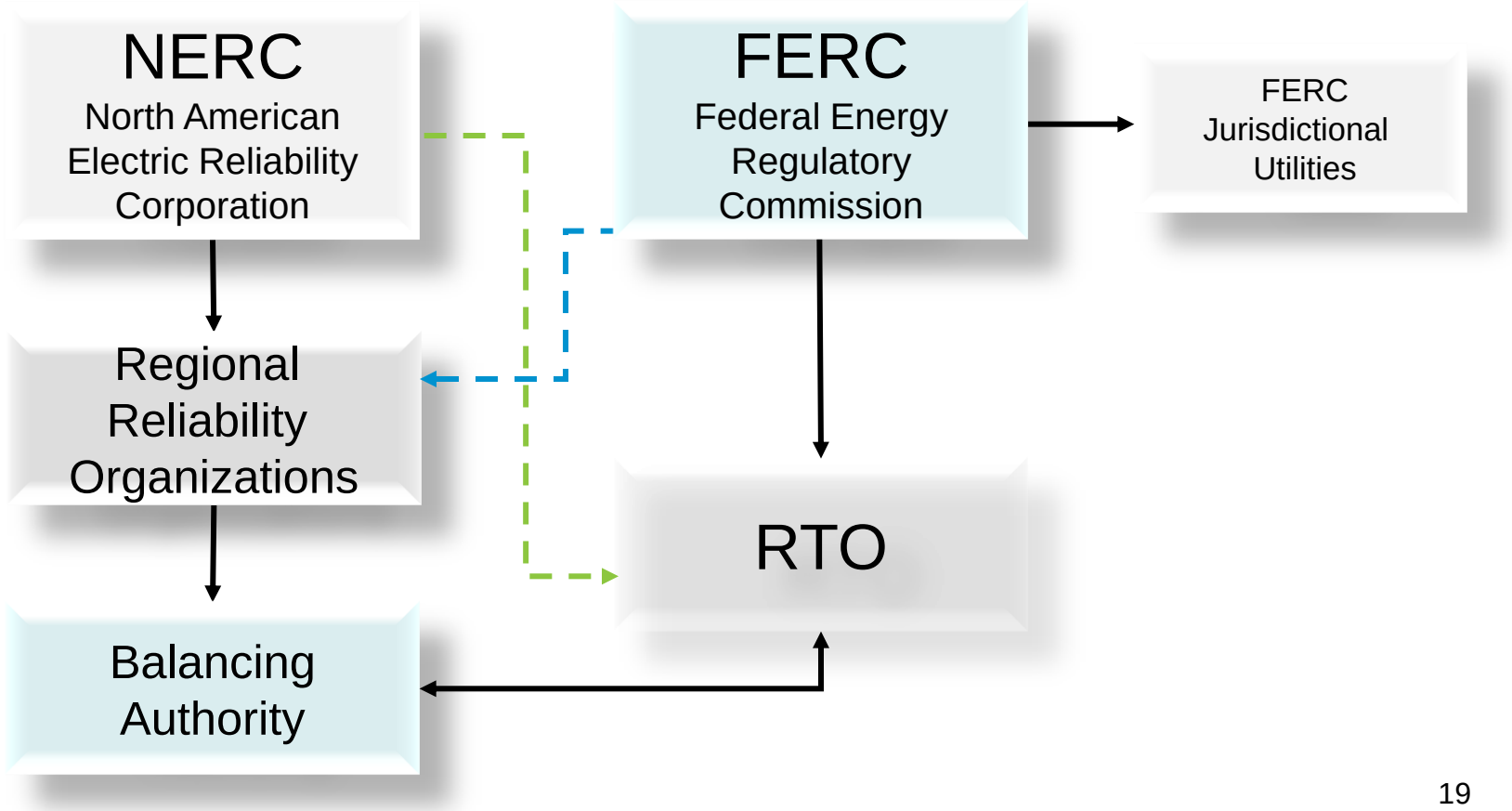
HOW DO RTOs ENSURE RELIABILITY?

- Grid Operations
  - Monitors energy transfer on the high voltage system
  - Meeting national and regional reliability standards
  - Congestion management
  - Transmission outage coordination
- Supply/Demand Balance
  - Dispatch reliability
  - Load Forecast accuracy
  - Wind forecasting accuracy
  - Managing unscheduled flows

TRANSMISSION PLANNING

- Management of a regional transmission planning process that includes an identification of public policy requirements
- Compliance with cost allocation principles in the planning process
- Coordination with Independent State Agency Committee (ISAC) on regional issues
- Increased opportunities for stakeholder input in the planning process

HOW ARE RTOs REGULATED?



HOW DO STATE REGULATORS WORK WITH RTOS?

State Regulators' Interactions at the RTO:

- Input into RTO's policy and operational issues through regional state committee organizations funded through the OATT (e.g. OPSI, OMS, RSC)
- Direct requests for information from RTOs about operational issues impacting the state or the region n
- Participation in the RTO's regional transmission planning process
- Management of renewable energy credits through the General Attribute Tracking System

HOW DO STATE REGULATORS WORK WITH RTOs?

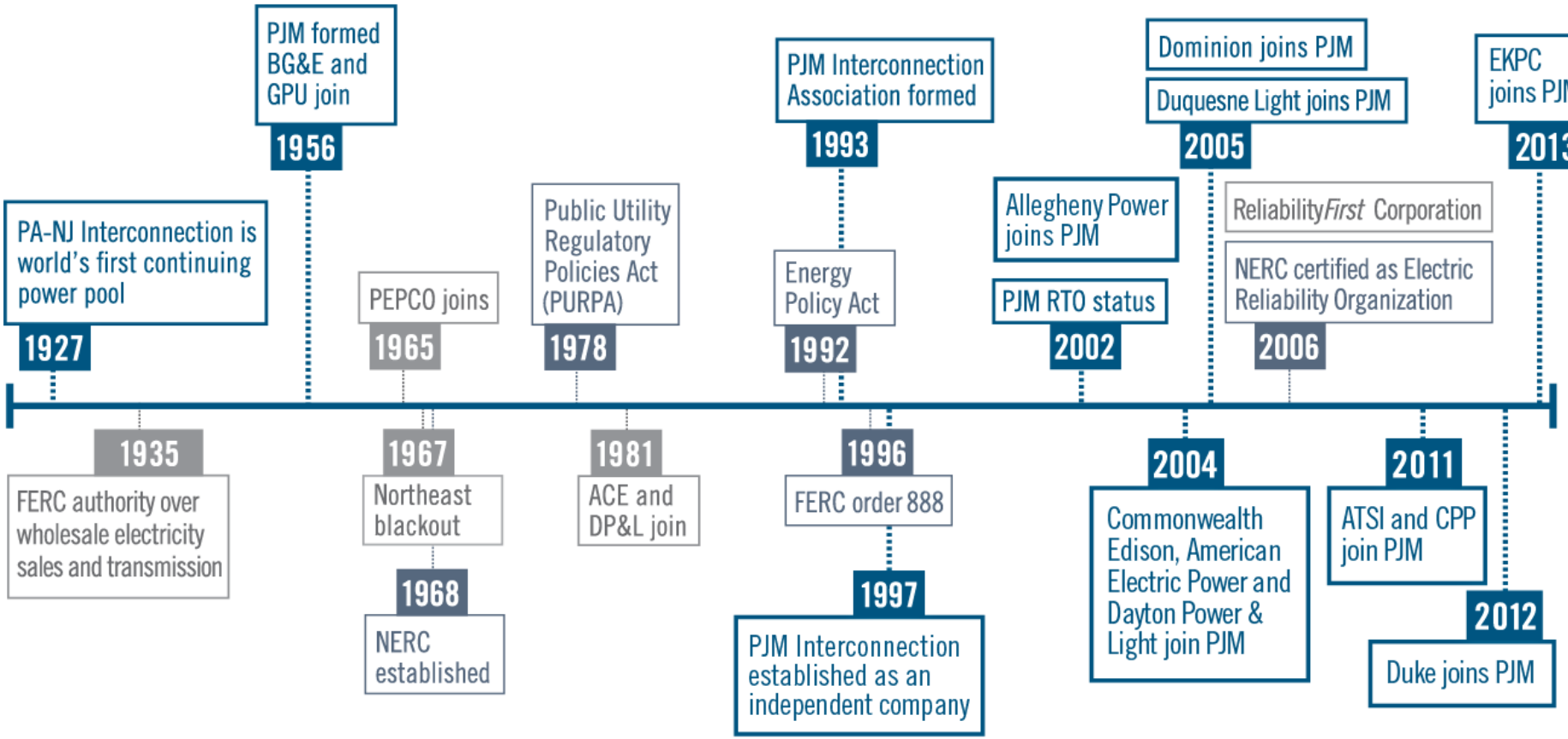
RTO's interactions with State Regulators:

- Cost allocation for transmission upgrades
- Allocation of transmission rights in the RTO market
- Transmission siting and planning
- Setting the state approach for regional resource adequacy

PJM INTERCONNECTION, INC. (PJM)

Source: PJM

THE HISTORY OF PJM



AS PART OF THE EASTERN INTERCONNECTION

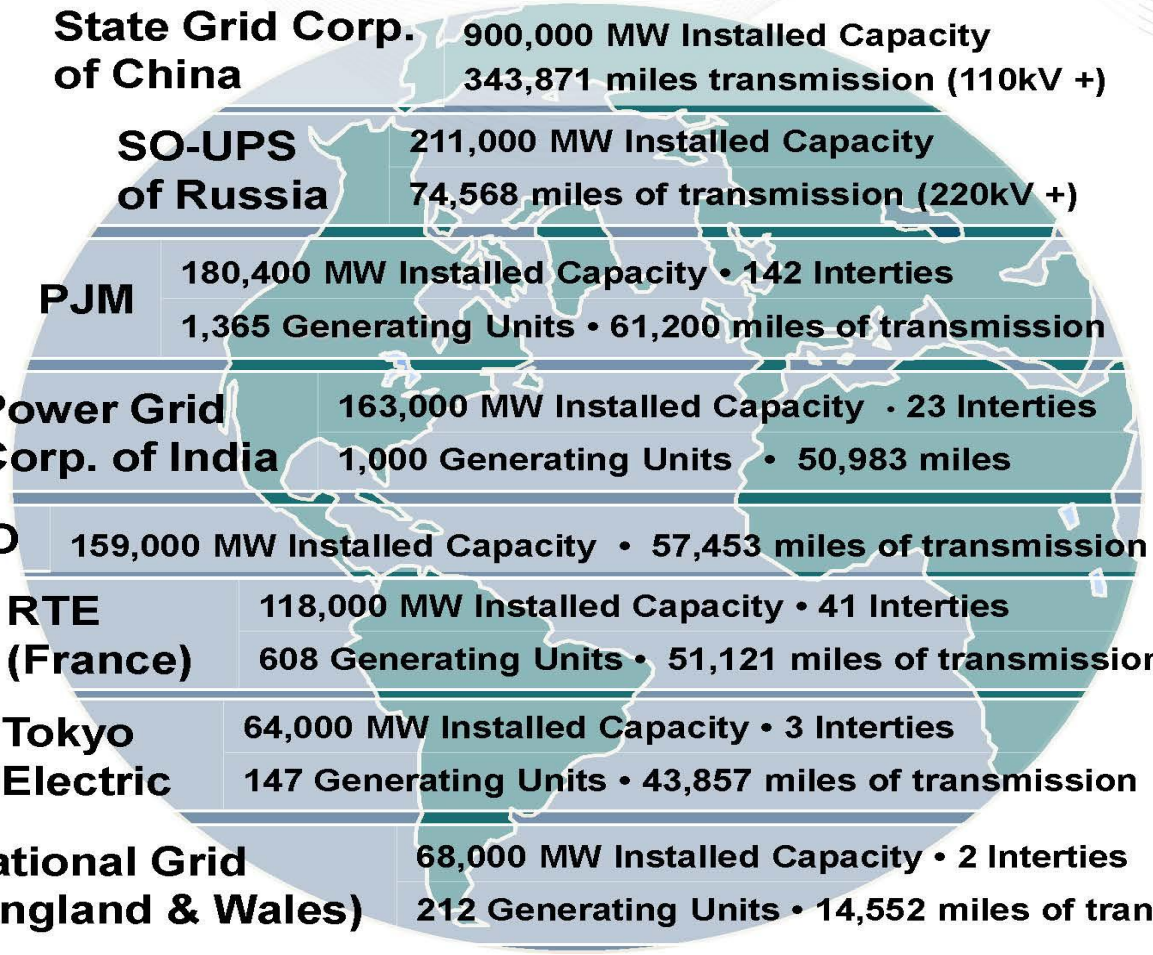
21% of U.S. GDP produced in PJM

KEY STATISTICS

Member companies	900+
Millions of people served	61
Peak load in megawatts	165,492
MWs of generating capacity	183,604
Miles of transmission lines	62,556
2013 GWh of annual energy	791,089
Generation sources	1,376
Square miles of territory	243,417
States served	13 + DC

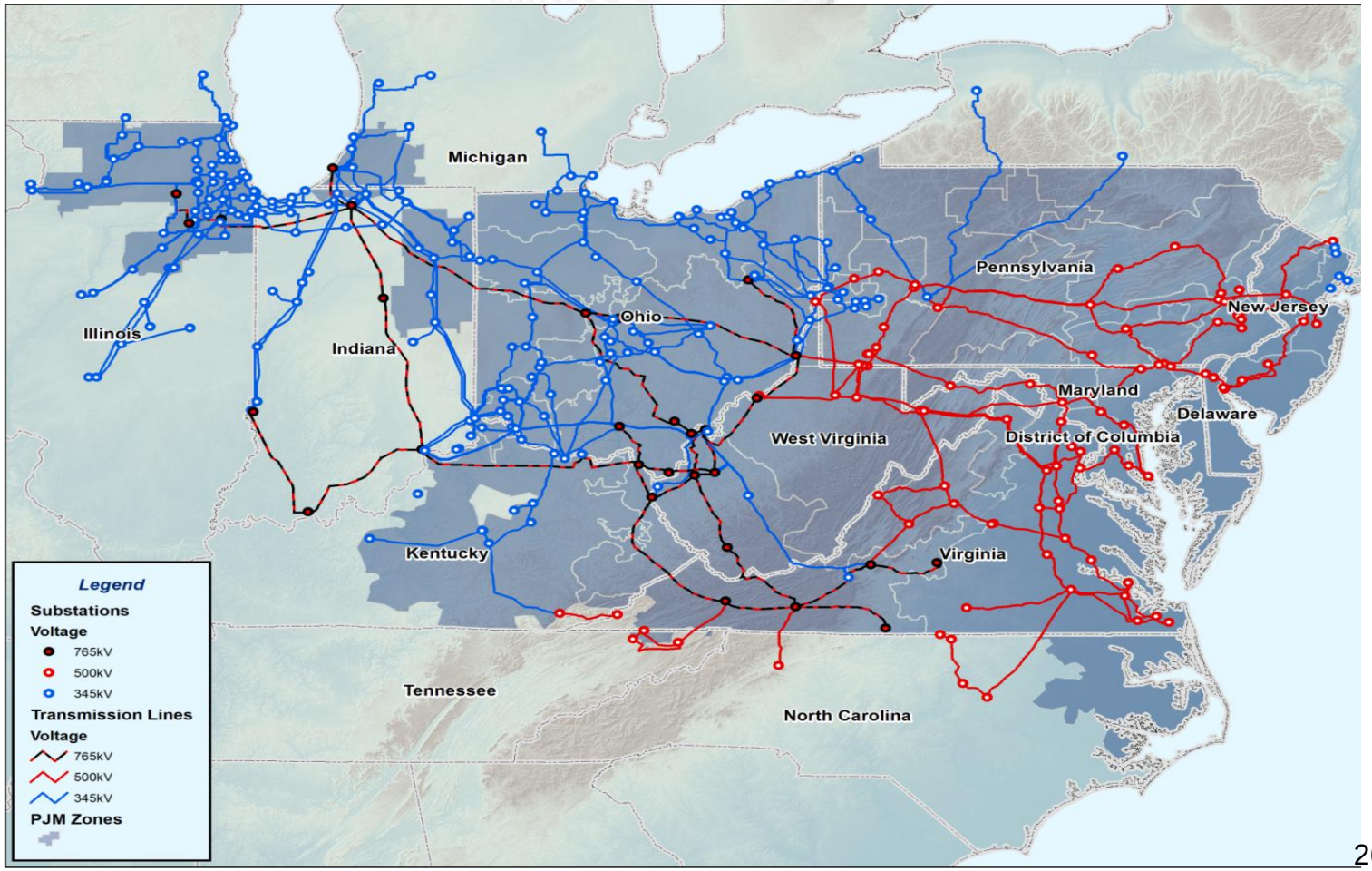
As of 4/1/2014

PJM in the World

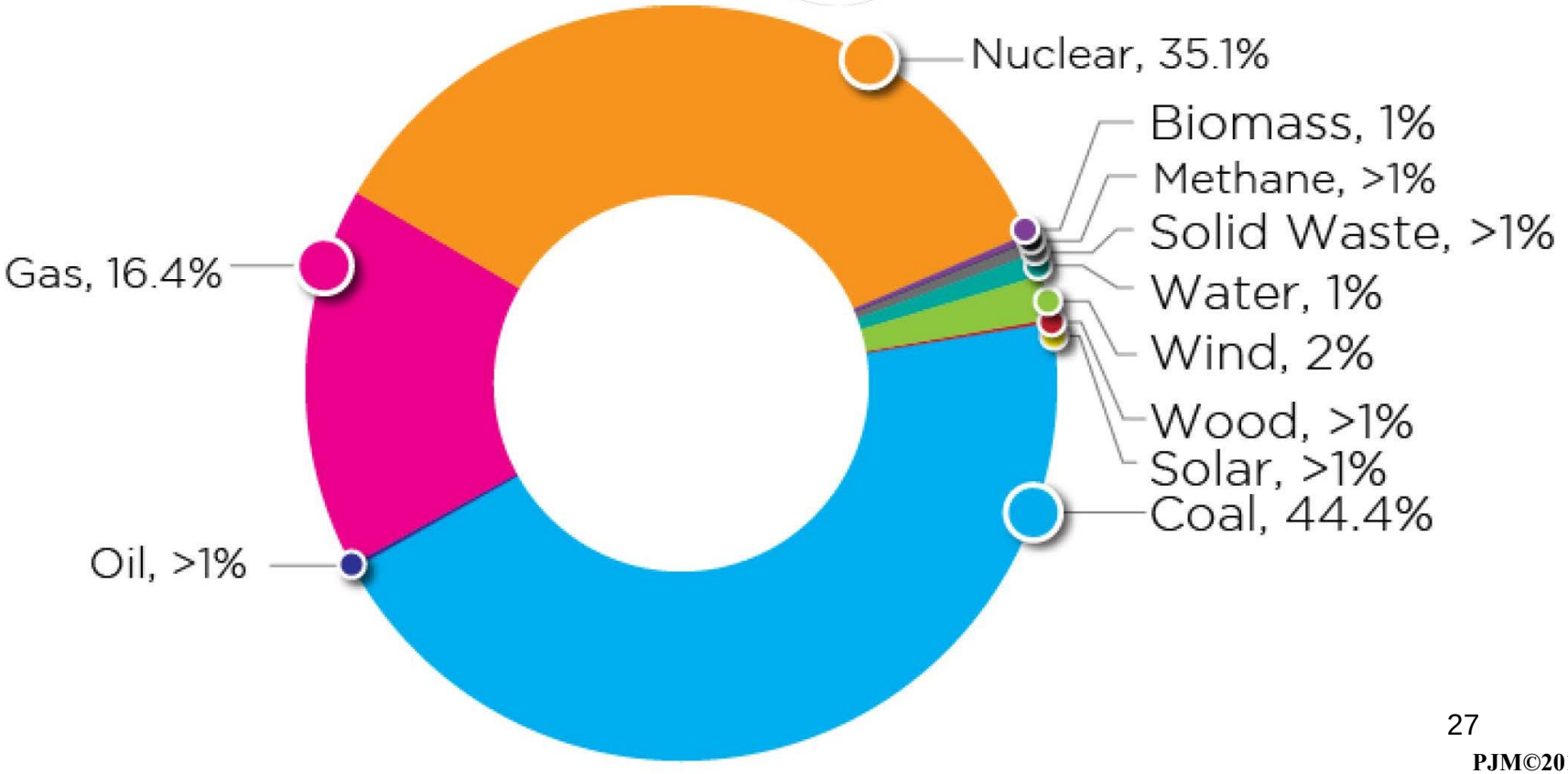


As of March 2011

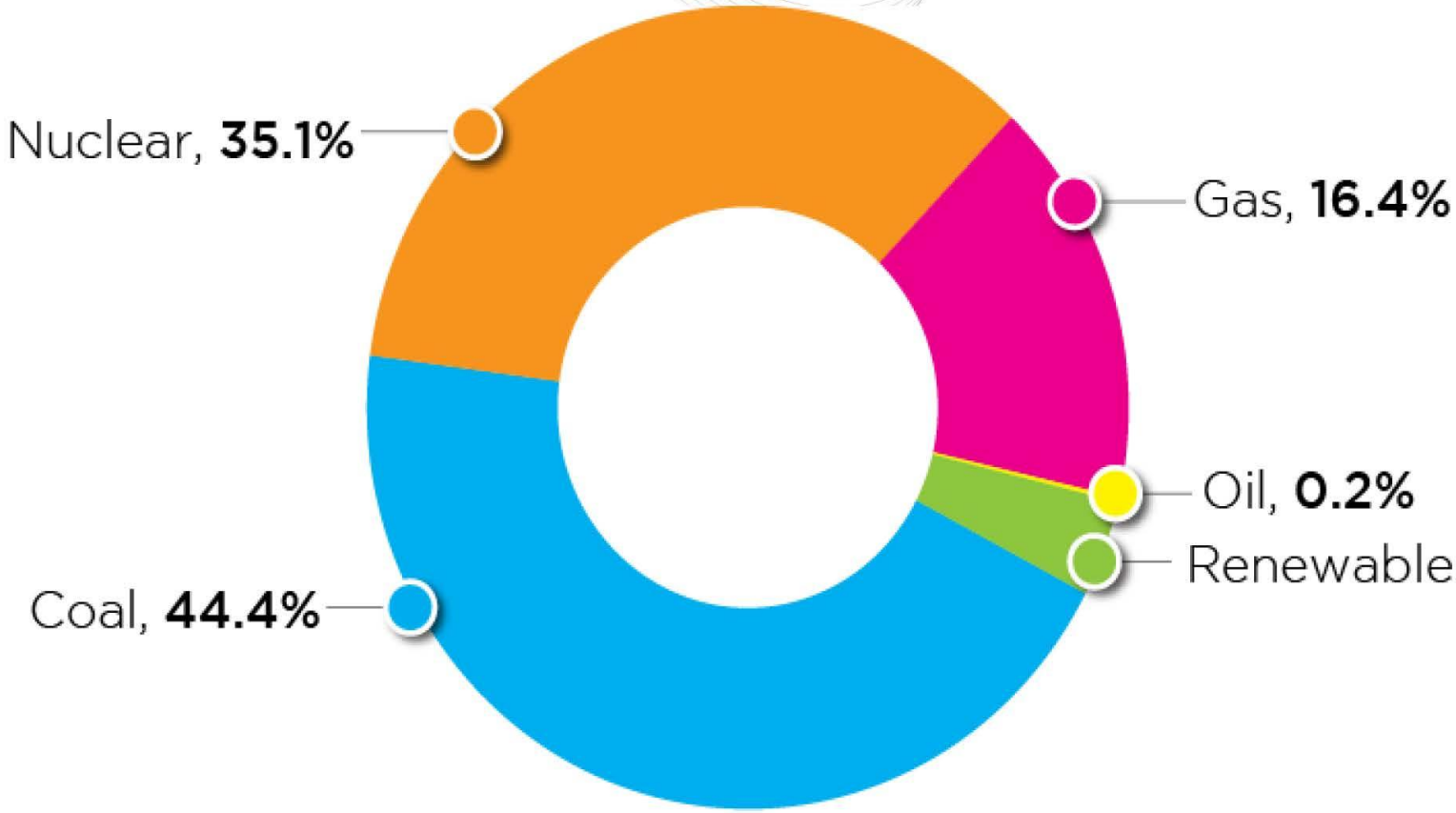
BACKBONE TRANSMISSION



2013 PJM Energy by Fuel Type



2013 PJM Capacity Mix



REGIONAL MARKET BENEFITS

- Operational Diversity
- Price, Data, Information Transparency
- Transmission Planning /Coordination
- Regulatory / Reliability Compliance
- Wholesale Market creates platform to enable demand response
- Wholesale Market creates platform to enable renewable resources
- Wholesale market lowers overall cost of environmental compliance

Regional Market Benefits

Reliability –

resolving transmission constraints, gains in economic efficiency from regional reliability planning – **from $470 million to $490 million in annual savings**

Generation investment –

reduced reserve requirements and increased demand response result in decreased need for infrastructure investment – **from $640 million to $1.2 billion in annual savings**

Regional Market Benefits

Energy production cost –

efficiency of centralized dispatch over a large region – **from $340 million to $445 million in annual savings**

Grid services –

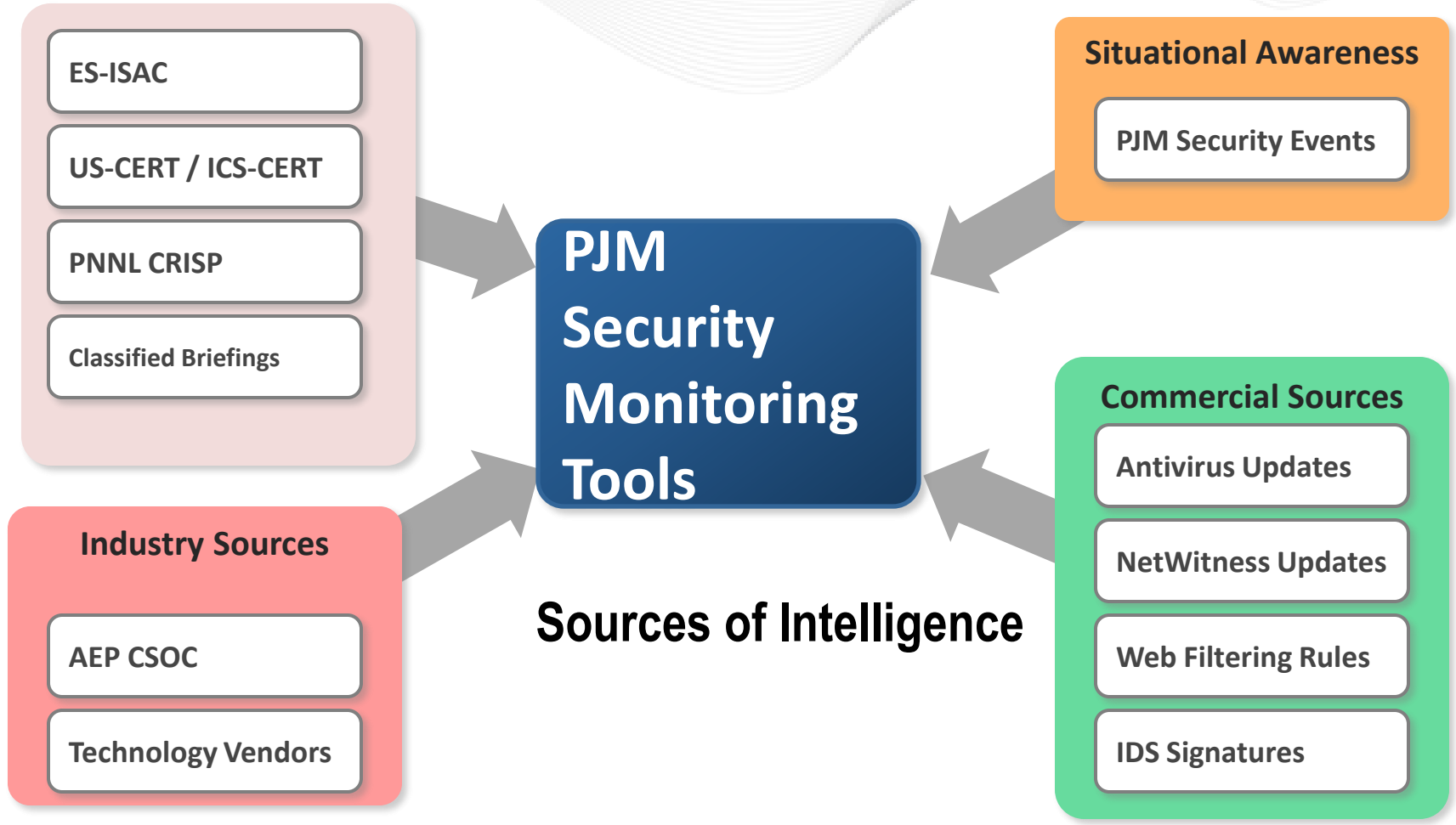
cost-effective procurement of synchronized reserve, regulation – **from $134 million to $194 million in annual savings**

Regional Market Benefits

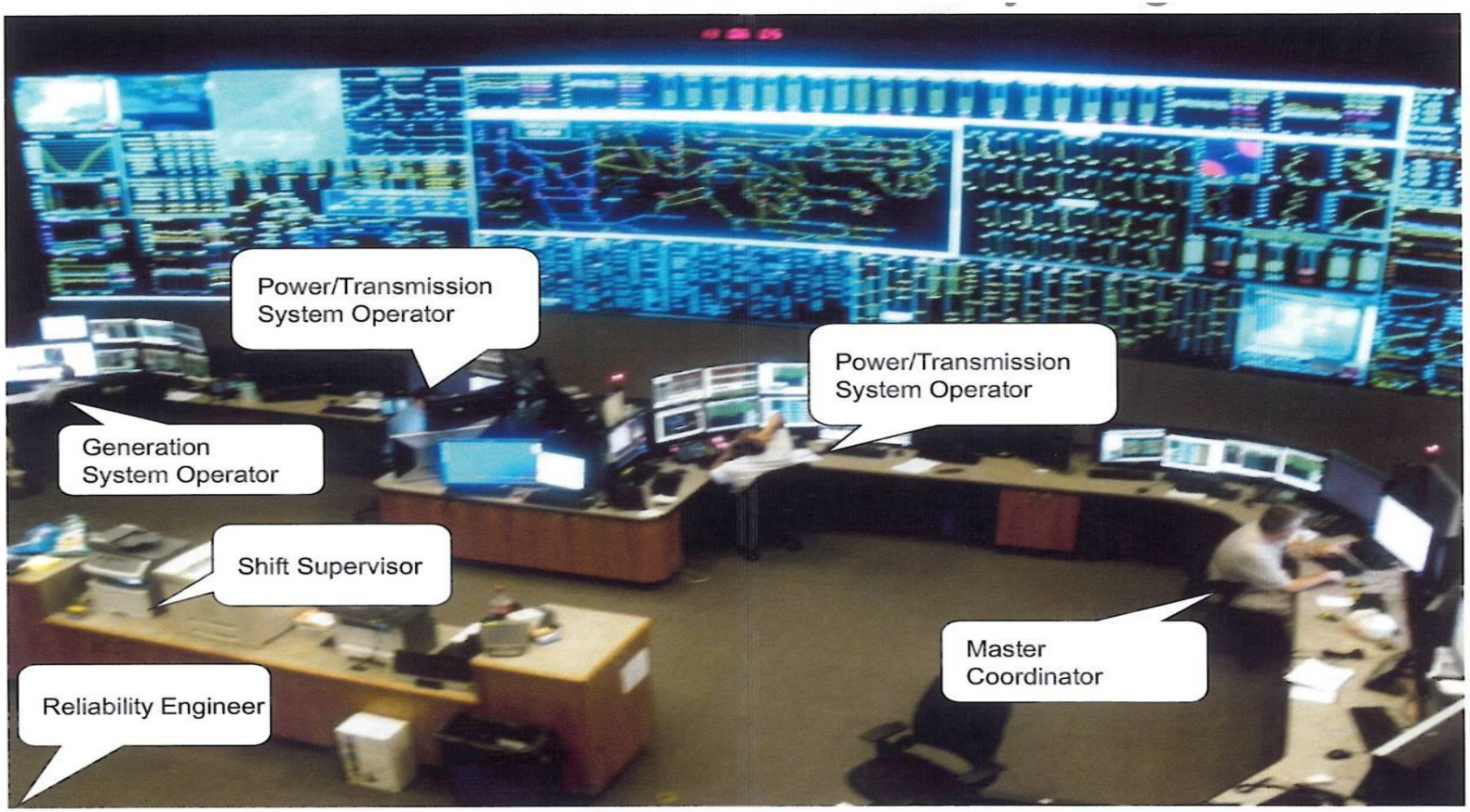
Total – as much as $2.3 billion in savings to the region each year

pjm

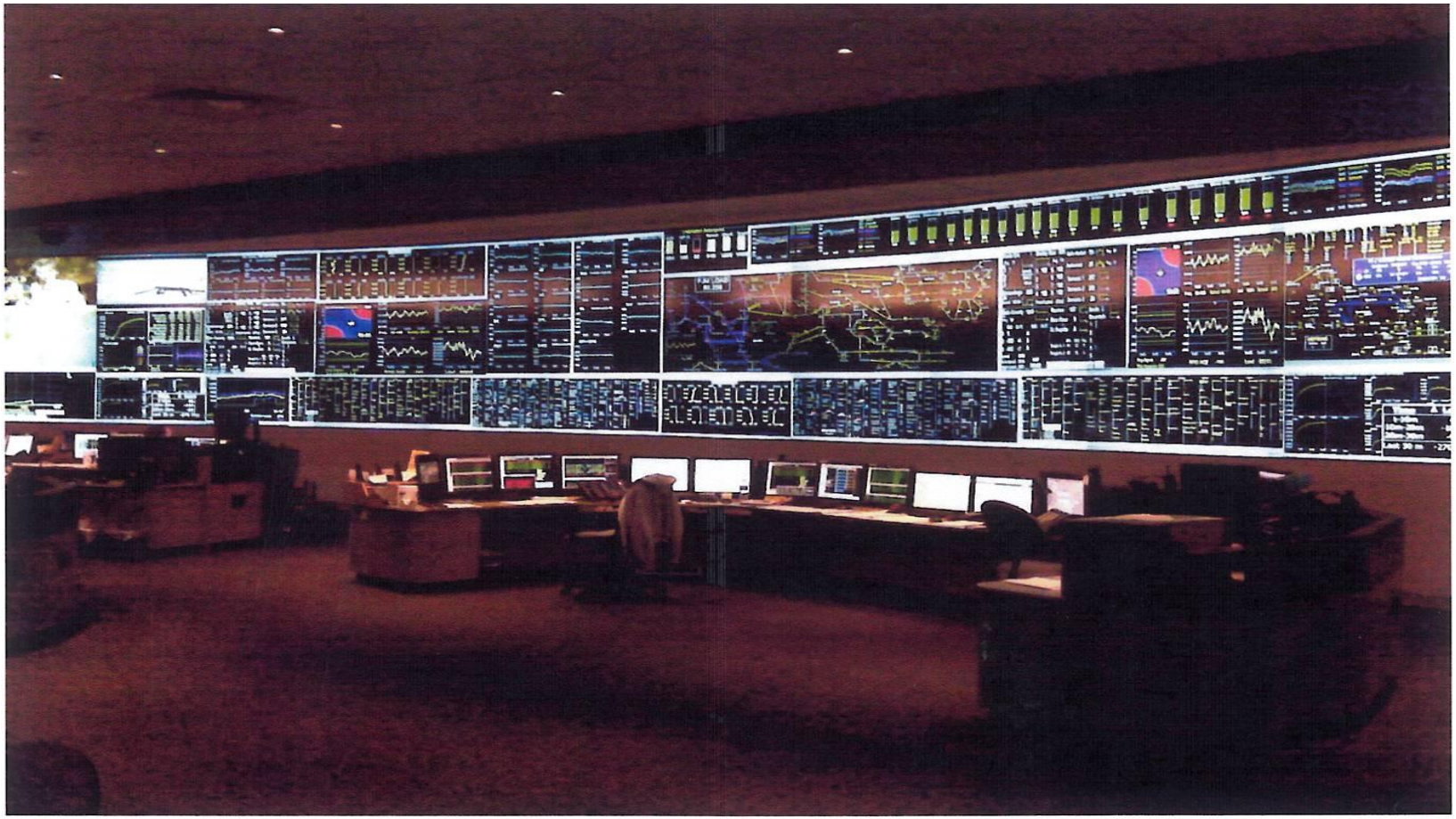
Inputs to Security Risk Assessment


ES-ISAC
US-CERT / ICS-CERT
PNNL CRISP
Classified Briefings
Situational Awareness
PJM Security Events
PJM Security Monitoring Tools
Industry Sources
AEP CSOC
Technology Vendors
Commercial Sources
Antivirus Updates
NetWitness Updates
Web Filtering Rules
IDS Signatures
Sources of Intelligence

VALLEY FORGE CONTROL ROOM

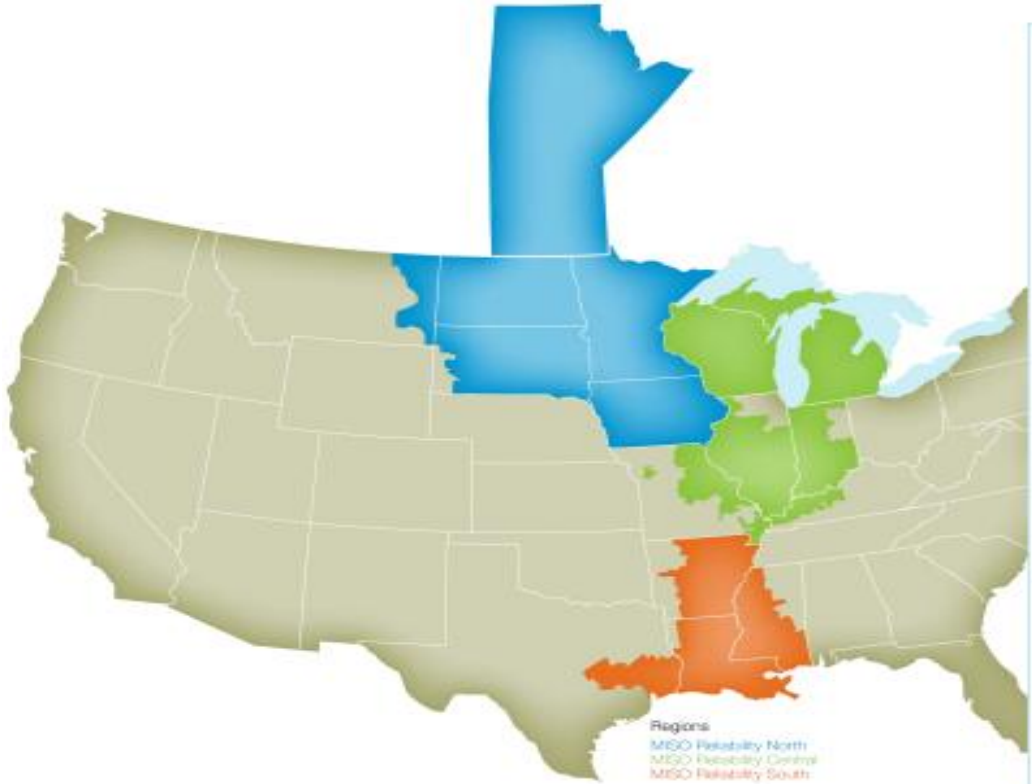


MILFORD CONTROL ROOM



MIDCONTINENT ISO (MISO)

MISO: Who We Are

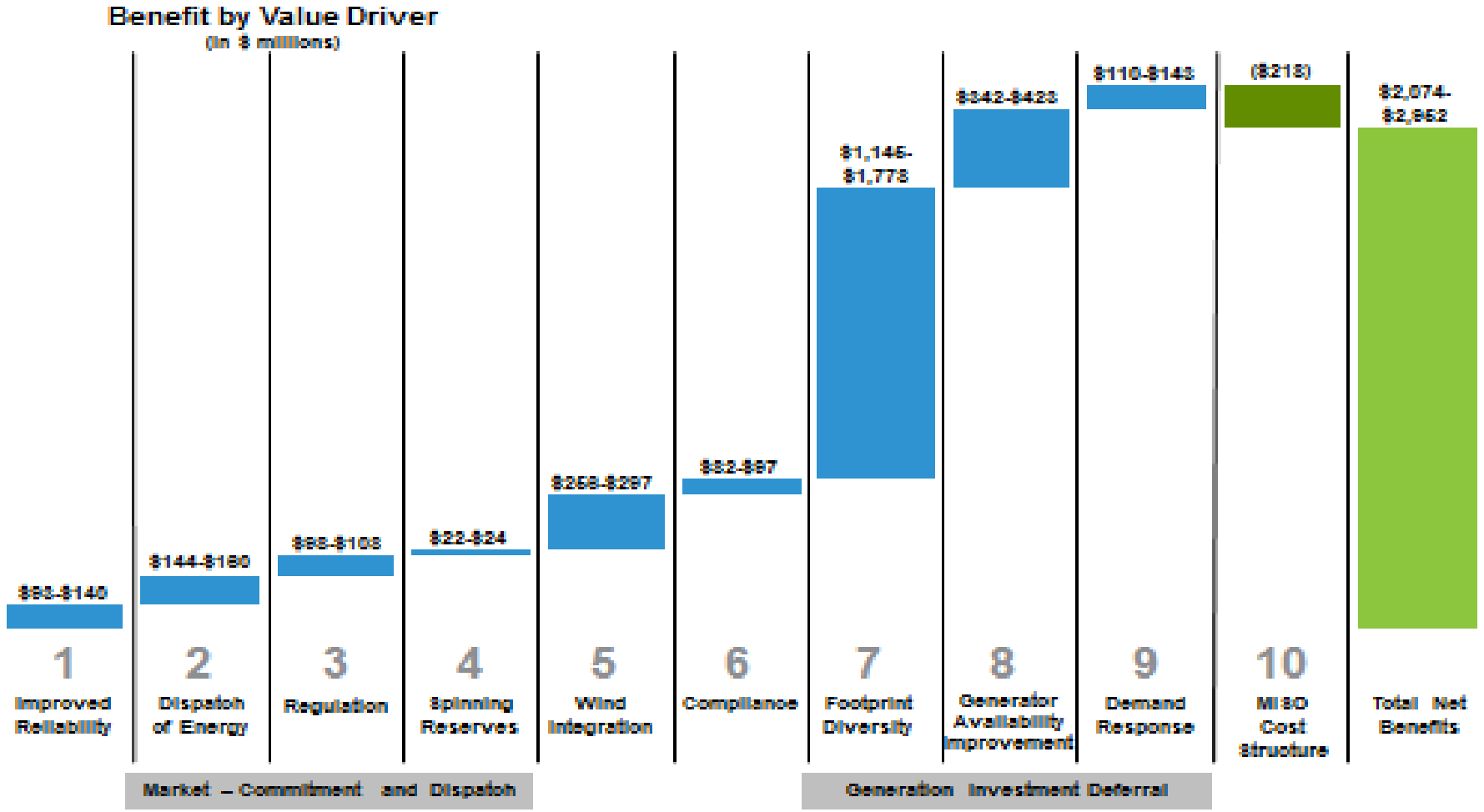


Key Statistics

Members	169
Market Participants	408
Millions of People Served	42
Peak Load (MW)	132,893
MWs of Generating Capacity	252,980
Miles of Transmission Lines	65,800
Generation Sources	6301
Square Miles of Territory	900,000
States Served	15

Plus Manitoba Province, Canada

MISO's 2013 Value Proposition



MISO CONTROL ROOM

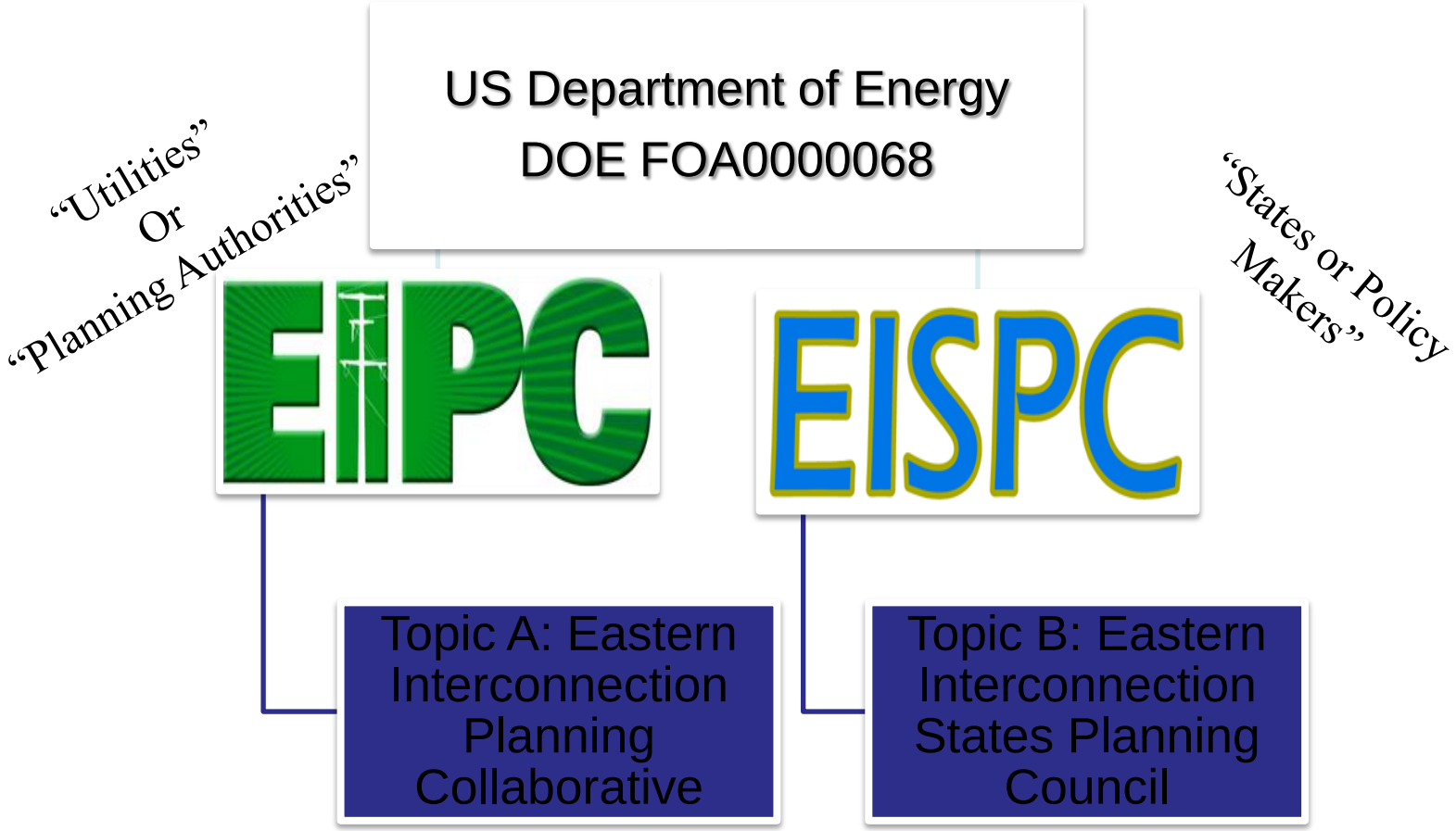
RTO TAKE AWAYS

- RTOs in the U.S. ensure the reliability of the electric grid, improve regional transmission planning and have provided substantial economic benefits in the regions in which they operate for more than a decade
- While there are minimum characteristics and functions common to all U.S. RTOs, there are operational variations that are tailored to the region, to the fuel mix and to the existing regulatory structure

An Overview of the Eastern Interconnection States Planning Council

Source: EISPC

EASTERN INTERCONNECTION PLANNING



Source: EISPC

ACKNOWLEDGEMENT AND DISCLAIMER

Acknowledgement:

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Disclaimers:

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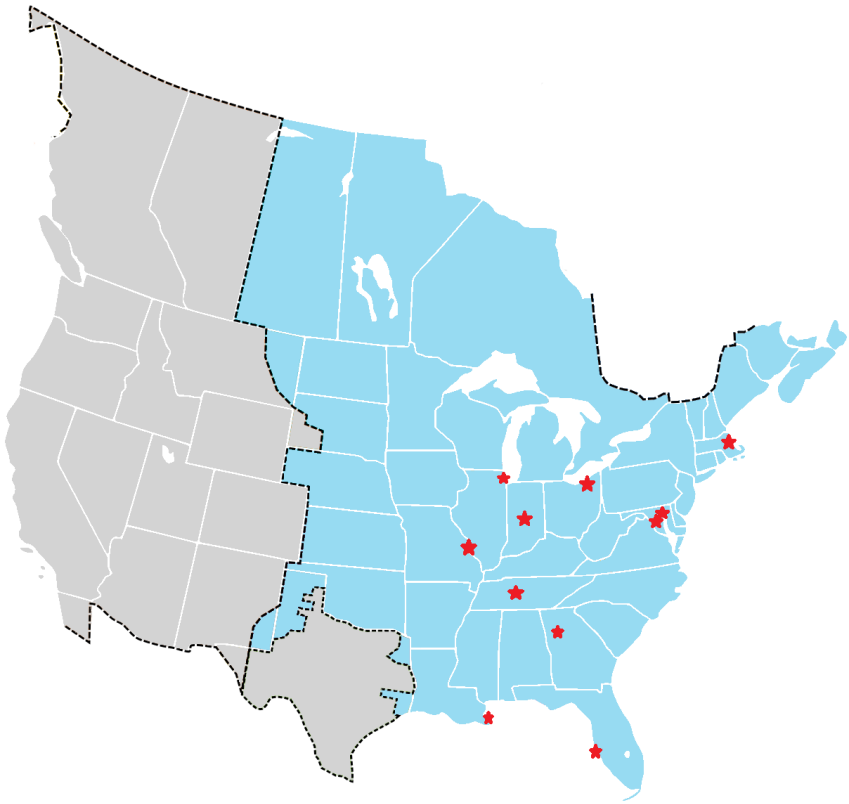
Source: EISPC

Convening Role for State Energy Offices and Utility Commissions

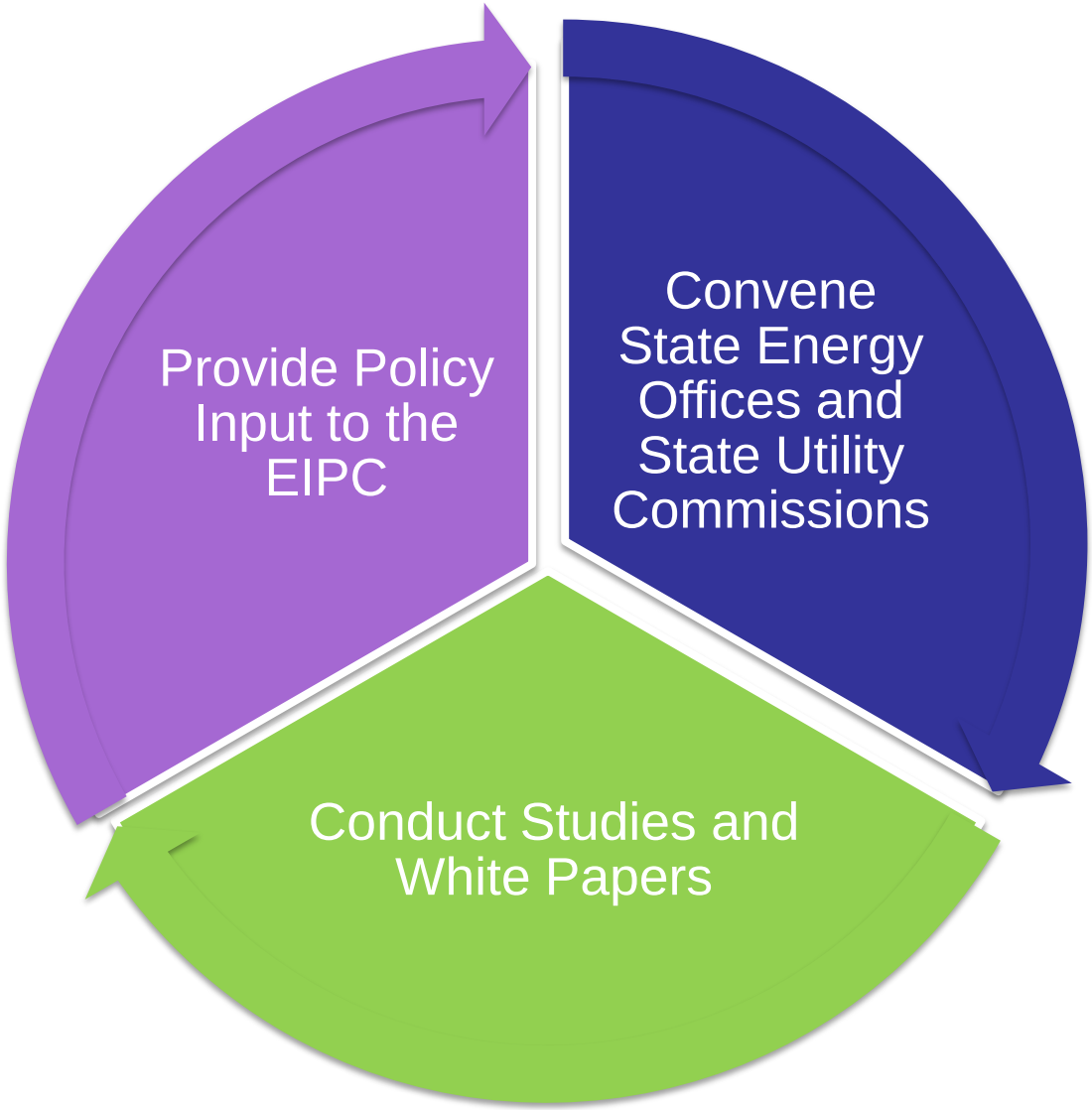
EISPC provides a forum for the 39 states, the District of Columbia, the City of New Orleans, and 6 Canadian provinces that compose the Eastern Interconnection to discuss and analyze immediate and long-term issues of mutual concern. The EISPC forum, because it requires consensus, serves as an "honest broker" for objective public policy analysis with an emphasis on collaboration and advancing the analytical tools available to states. There are two representatives per state including one commissioner and a designee of the Governor.



Stars on the map represent past locations of EISPC Council Meetings

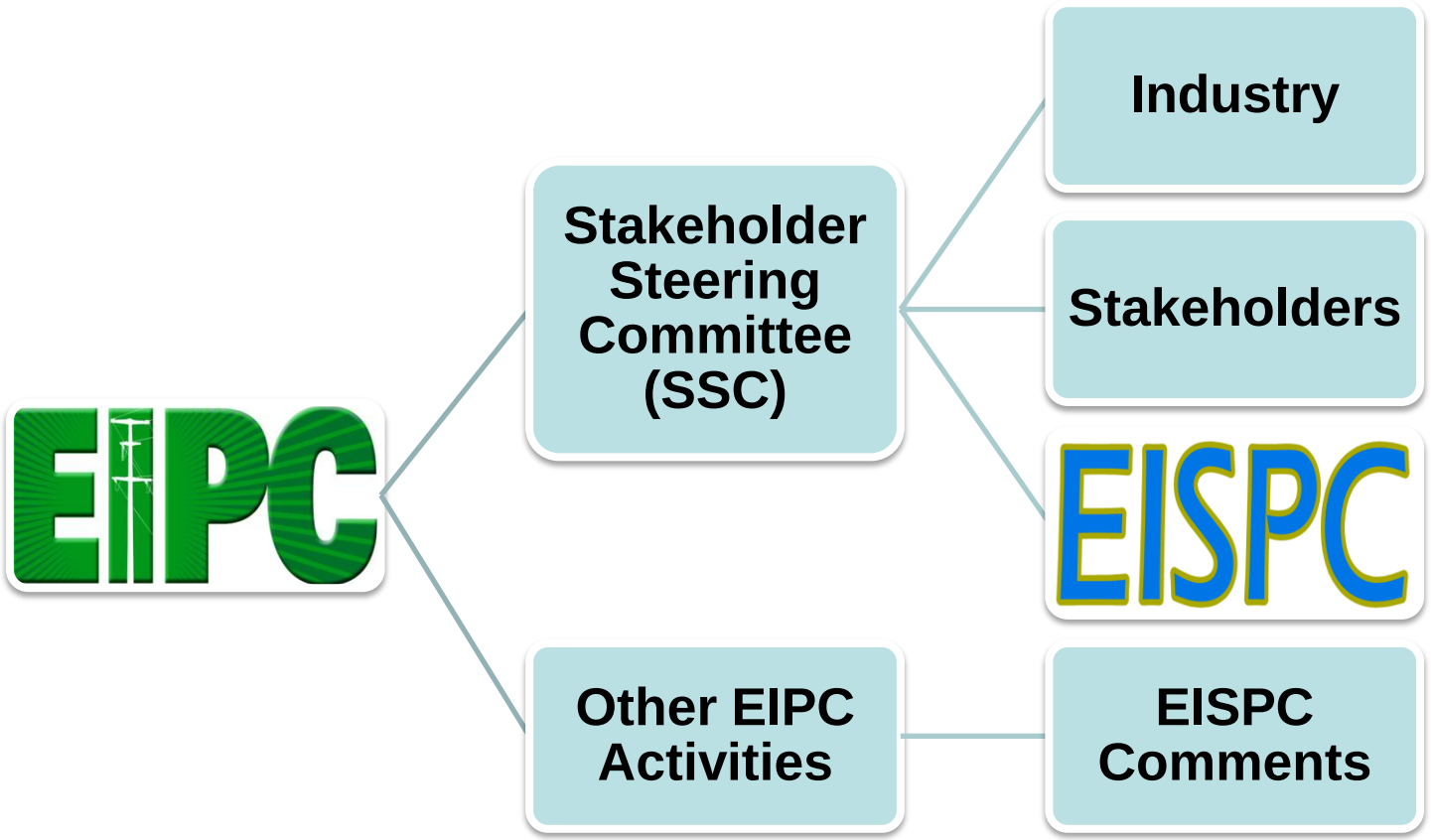
Source: EISPC

WHAT DOES EISPC DO?



Source: EISPC

PARTICIPATION IN TOPIC A (EIPC) ACTIVITIES



1/3 of the SCC membership are EISPC representatives

Source: EISPC

RELEVANT STUDIES AND WHITE PAPERS

Changing Resource Mix

- State by State Demand Side Resources
- Current and Future Direction of the Coal Industry
- Current and Future Direction of the Nuclear Industry
- Electric and Natural Gas Interdependencies

Energy Zones

- Transmission Planning
- Energy Zones Mapping Tool
- State by State Public Policy Inventory

Load Growth Patterns / Existing Transmission

- Co-Optimization
- Load Forecasting Case Studies

Source: EISPC

ENERGY ZONES MAPPING TOOL

Web-Based GIS Tool

Includes nine (9) clean energy resource categories

Used to locate areas with high suitability for clean power generation in the EI

Searchable Energy Policy and Regulations Database

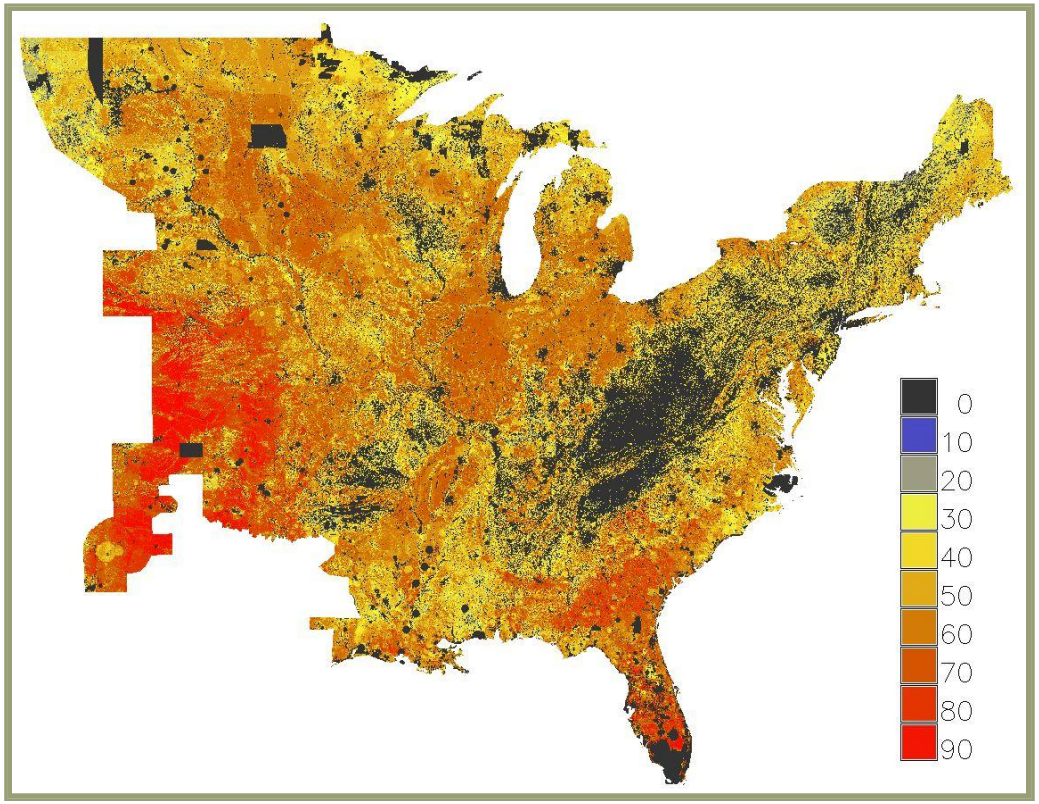
Available at http://eispctools.anl.gov

Source: EISPC

MODEL FOR UTILITY-SCALE SOLAR PHOTOVOLTAIC

Input Modeling Layers:

- Energy Potential: Solar PV
- Slope
- Land Cover Area
- Population Density
- Distance to Transmission
- Protected Lands
- Habitat



Source: EISPC

LIST OF MATERIALS IN APPENDIX

PJM Fact Sheets Overview and Contact Information
MISO Fact Sheets and Contact Information
SPP Overview and Contact Information
ISO-NE Fact Sheet, Resources and Contact Information
CAISO Fact Sheet
NYISO Fact Sheet
ERCOT Fact Sheet
EISPC Resources Links
EISPC Studies

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QUESTIONS AND DISCUSSION