PJM Regional Transmission Expansion Plan

Paul McGlynn
John Reynolds
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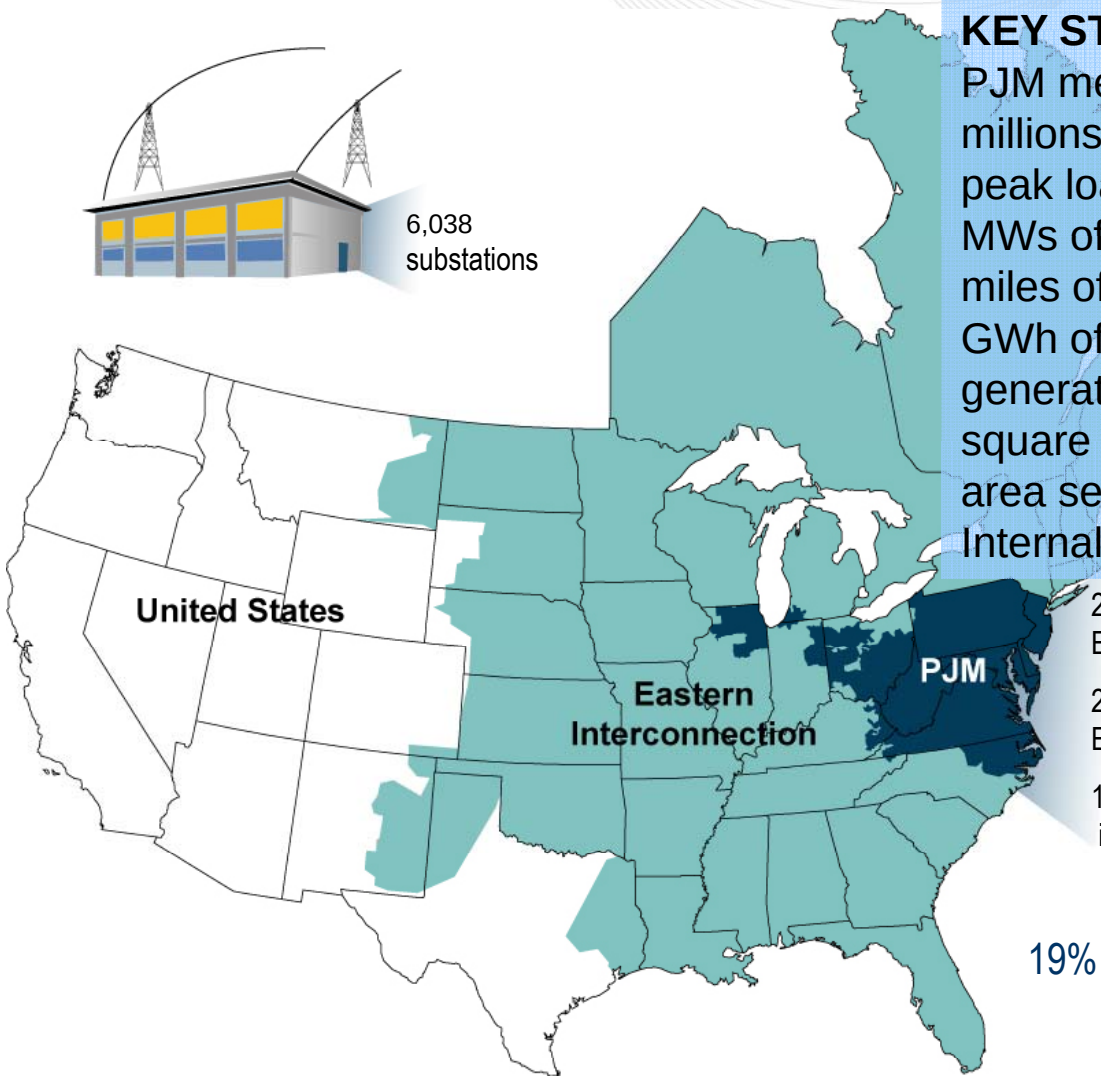
Topics for Today

- Planning Process Overview
- Compliance With Reliability Standards
  - North American Electric Reliability Council (NERC) Criteria – ERO
  - ReliabilityFirst Criteria (RFC), SERC – RROs
- Planning Assumptions
  - Load Forecasting
  - Generation Interconnections
- Load Deliverability Criteria
- Generator Deliverability Criteria
- Distributed Resources in Planning

PJM as Part of the Eastern Interconnection

6,038
substations



KEY STATISTICS

PJM member companies	500+
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	729,000
generation sources	1,271
square miles of territory	164,260
area served	13 states + DC
Internal/external tie lines	250

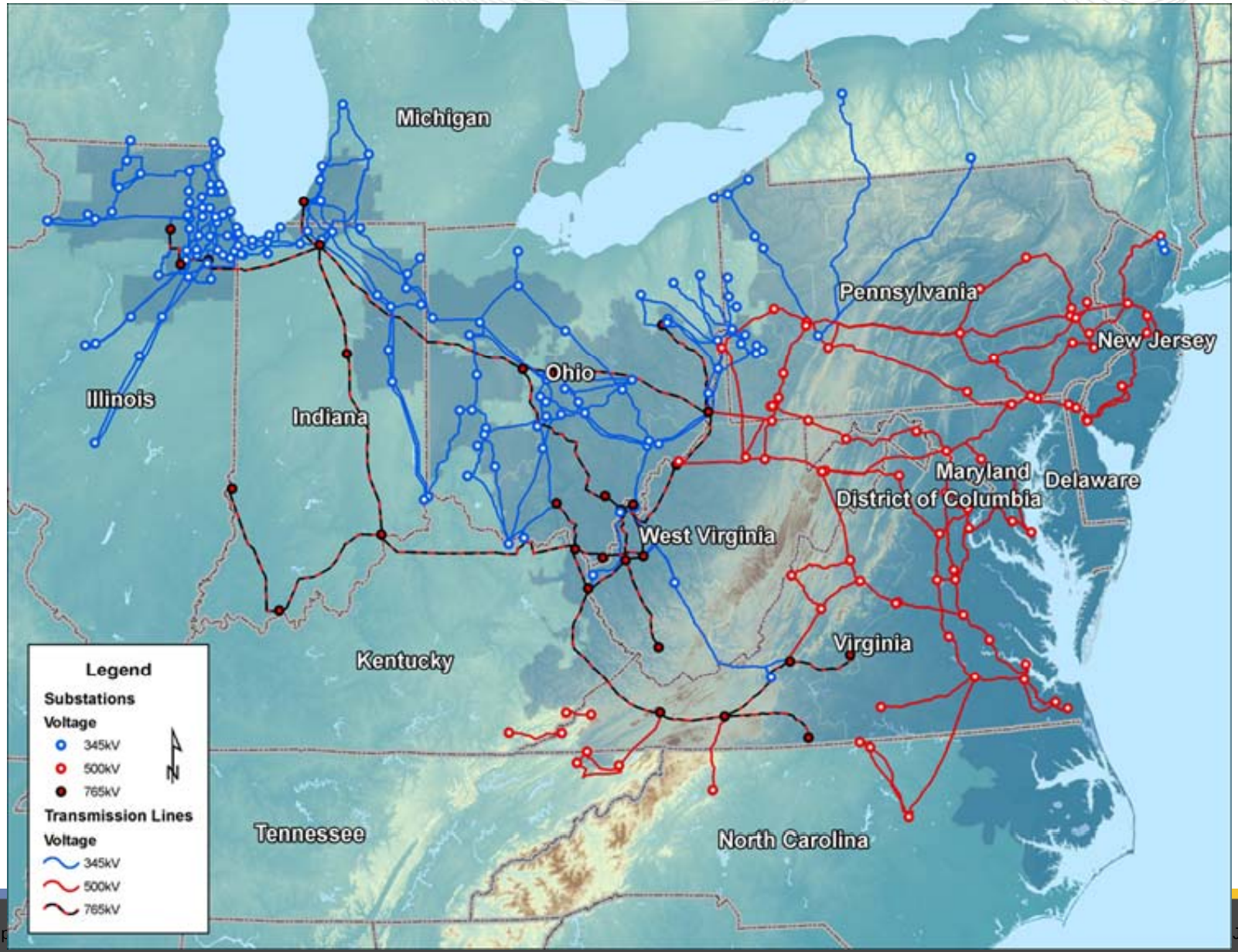
26% of generation in
Eastern Interconnection

23% of load in
Eastern Interconnection

19% of transmission assets
in Eastern Interconnection

19% of U.S. GDP produced in PJM

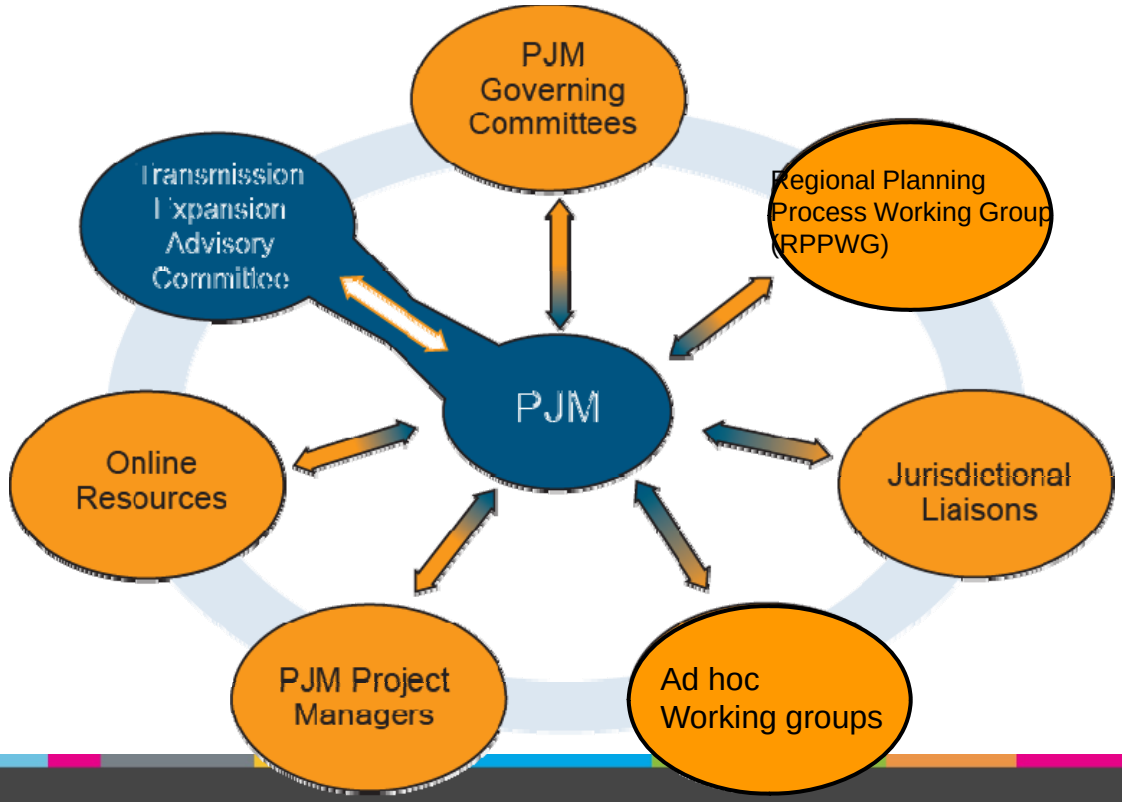
PJM Backbone Transmission

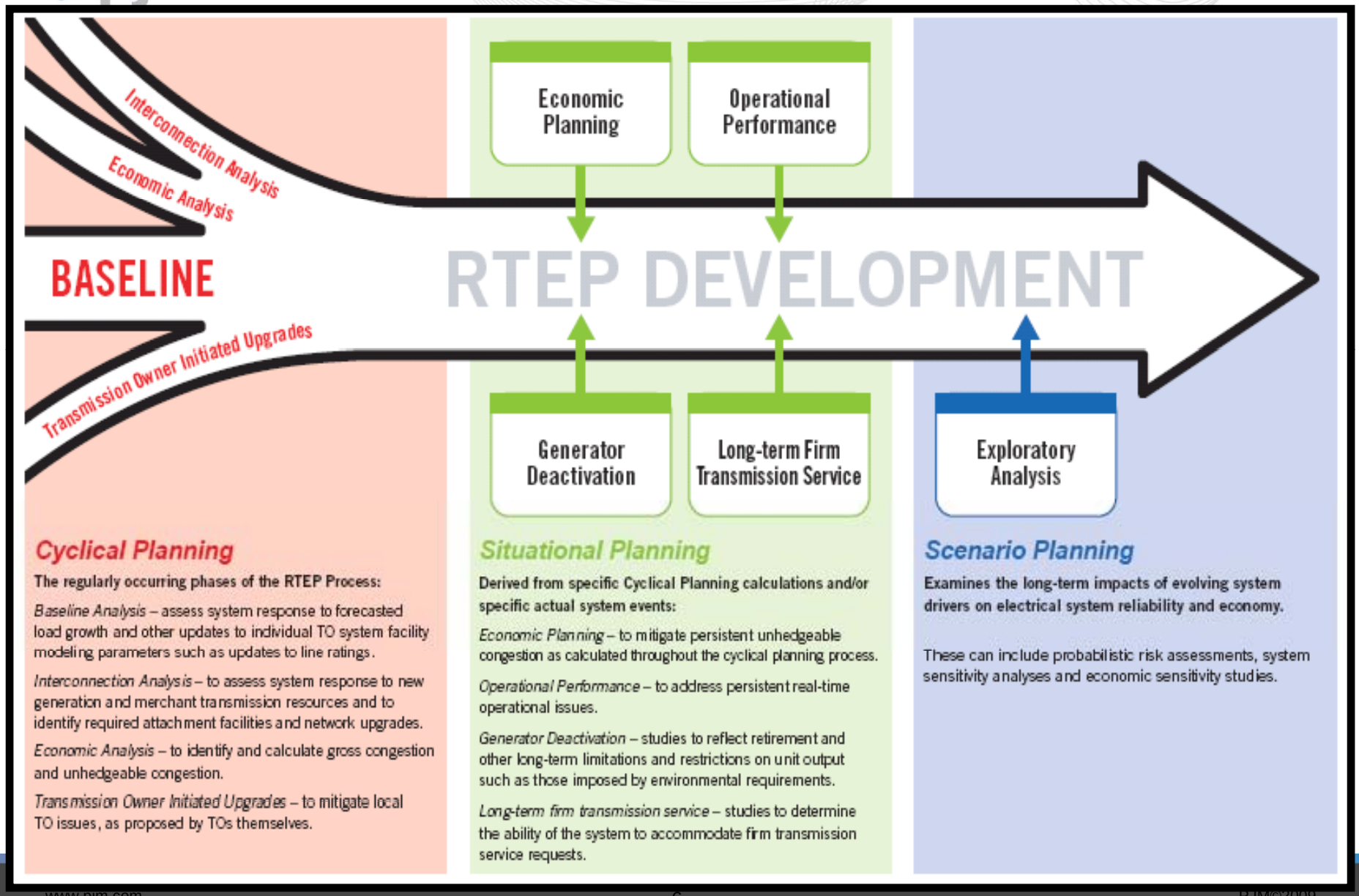


RTEPP - Stakeholder Participation

- Open
- Transparent
- Collaborative

- Topics…process, plans, FERC compliance, implementation issues…etc





Cyclical Planning

The regularly occurring phases of the RTEP Process:

Baseline Analysis – assess system response to forecasted load growth and other updates to individual TO system facility modeling parameters such as updates to line ratings.

Interconnection Analysis – to assess system response to new generation and merchant transmission resources and to identify required attachment facilities and network upgrades.

Economic Analysis – to identify and calculate gross congestion and unhedgeable congestion.

Transmission Owner Initiated Upgrades – to mitigate local TO issues, as proposed by TOs themselves.

Situational Planning

Derived from specific Cyclical Planning calculations and/or specific actual system events:

Economic Planning – to mitigate persistent unhedgeable congestion as calculated throughout the cyclical planning process.

Operational Performance – to address persistent real-time operational issues.

Generator Deactivation – studies to reflect retirement and other long-term limitations and restrictions on unit output such as those imposed by environmental requirements.

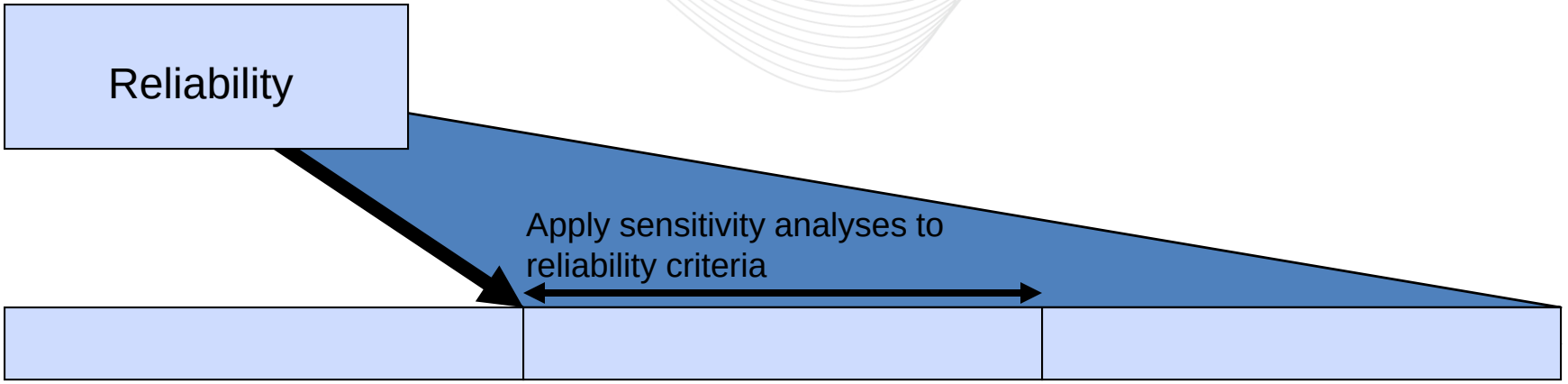
Long-term firm transmission service – studies to determine the ability of the system to accommodate firm transmission service requests.

Scenario Planning

Examines the long-term impacts of evolving system drivers on electrical system reliability and economy.

These can include probabilistic risk assessments, system sensitivity analyses and economic sensitivity studies.

Regional Planning Process – Reliability



Include all required upgrades at all voltage levels in RTEP

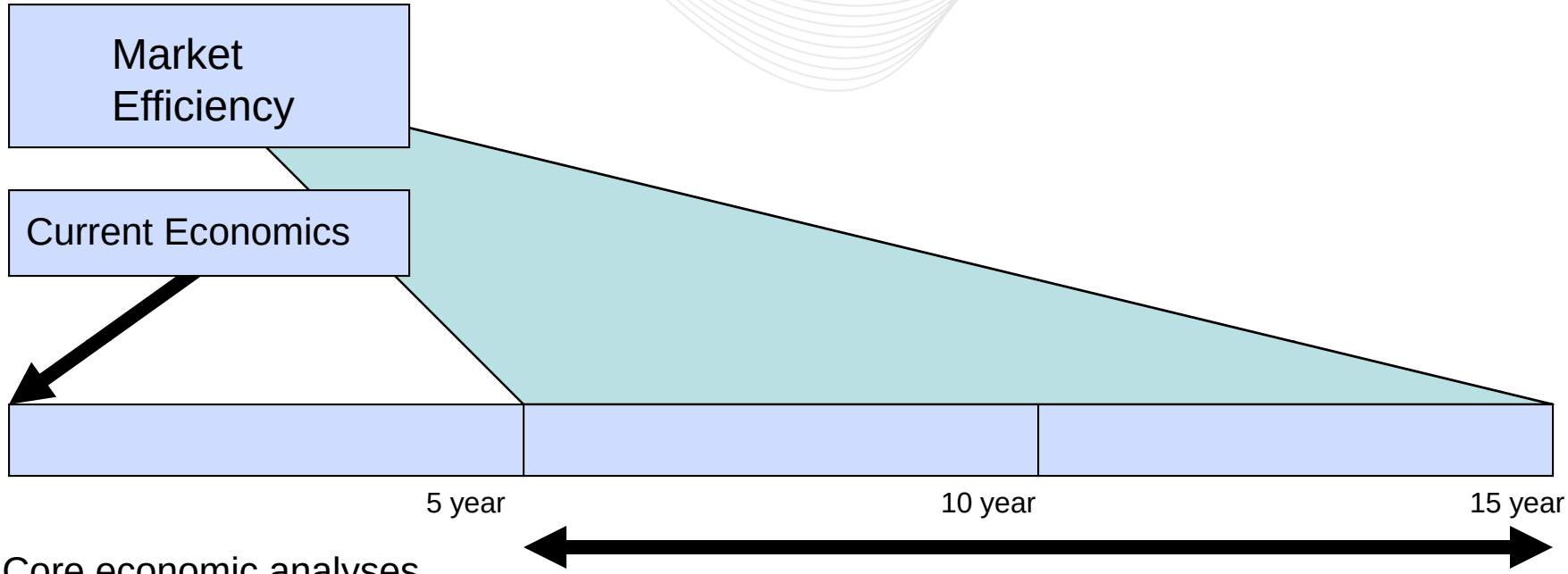
230-345 kV new construction included in RTEP

Identify 230-345 kV new construction requirements and continue to re-evaluate each year

500-765 kV upgrades included in RTEP

Pursue right-of-way acquisition for 500-765 kV projects

Regional Planning Process – Economics



Core economic analyses related to:

Production cost

Transmission congestion

Other econometric factors

Evaluate additional infrastructure requirements based on impact of market efficiency analysis assumptions.

Establish stakeholder committee to recommend scope of analysis and assumptions, and to review results and make upgrade recommendations to the board.

- North American Electric Reliability Council (NERC) Criteria – ERO
  - **R1.1.** Be made annually.
  - **R1.2.** Be conducted for near-term (years one through five) and longer-term (years six through ten) planning horizons.
  - **R1.3.** Be supported by a current or past study and/or system simulation testing that addresses each of the following categories, showing system performance following Table 1.
    - **R1.3.2.** Cover critical system conditions and study years as deemed appropriate by the responsible entity.
- ReliabilityFirst Criteria (RFC), SERC – RROs

- Load Forecast
  - Historical loads (weather variability)
  - Forward looking econometric data
- Generation
  - Existing generation
  - Future generation
  - Generation expected to retire
- Transmission Topology
  - What will the transmission system look like out in the future?

Load Deliverability: Emergency Import Analysis

- PJM's emergency import analysis is a two-step process:

1. **C**apacity **E**mergency **T**ransfer **O**bjective (CETO): Determine the required amount of emergency import capability into a defined area

2. **C**apacity **E**mergency **T**ransfer **L**imit (CETL): Determine the ability to import capacity assistance into that area

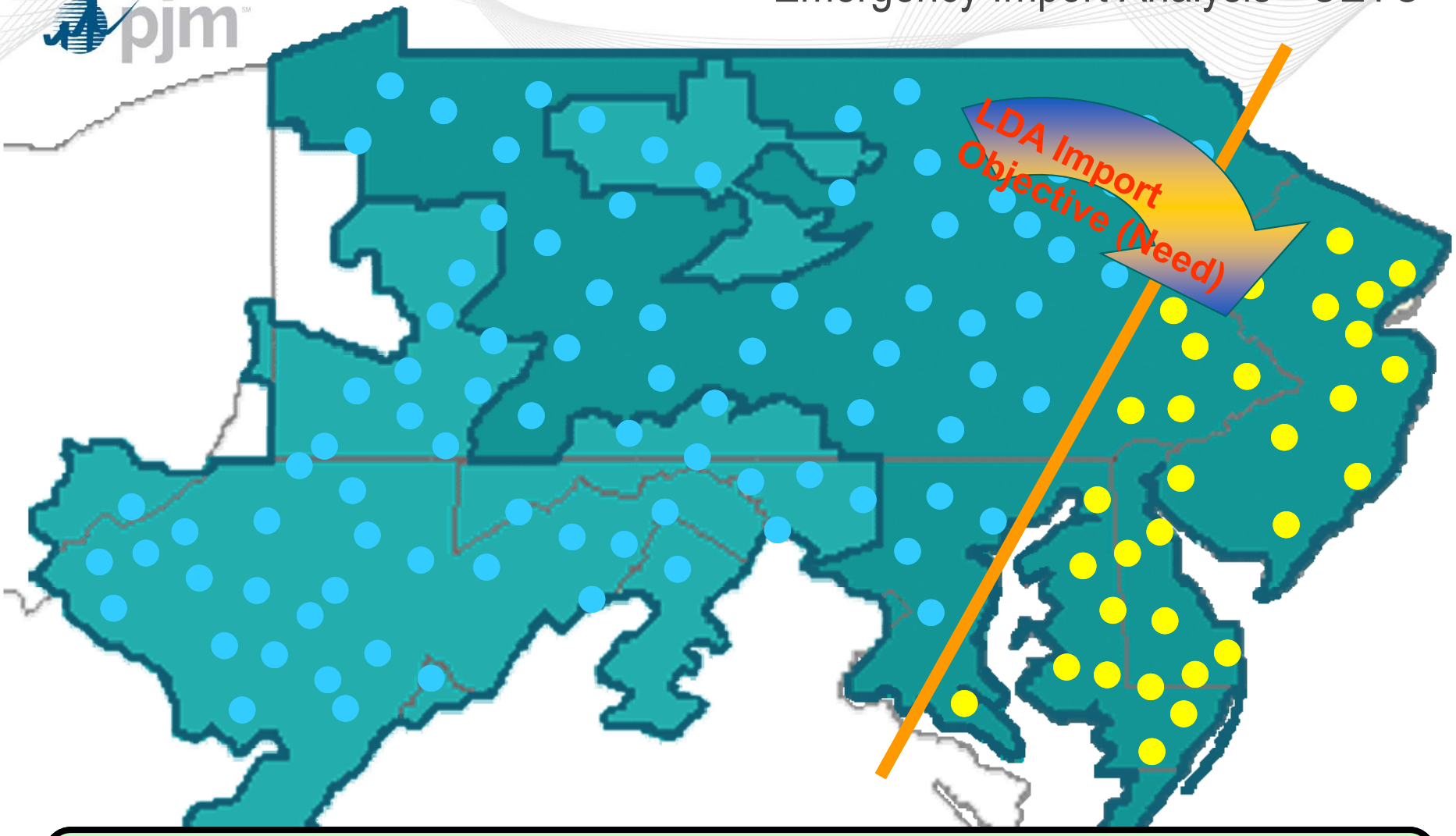
- PJM is divided into 23 “electrically cohesive” Load Deliverability Areas (LDAs). Each LDA is evaluated separately.

- The CETO study increases the amount of capacity imported into the LDA, measuring the resulting reliability index. (Ignores actual transmission characteristics).

- When the reliability index reaches 1-event-in-25-years, the associated import level is the calculated CETO.

- 1-event-in-25-years index refers to the frequency with which the LDA should shed load due to insufficient import capability only.

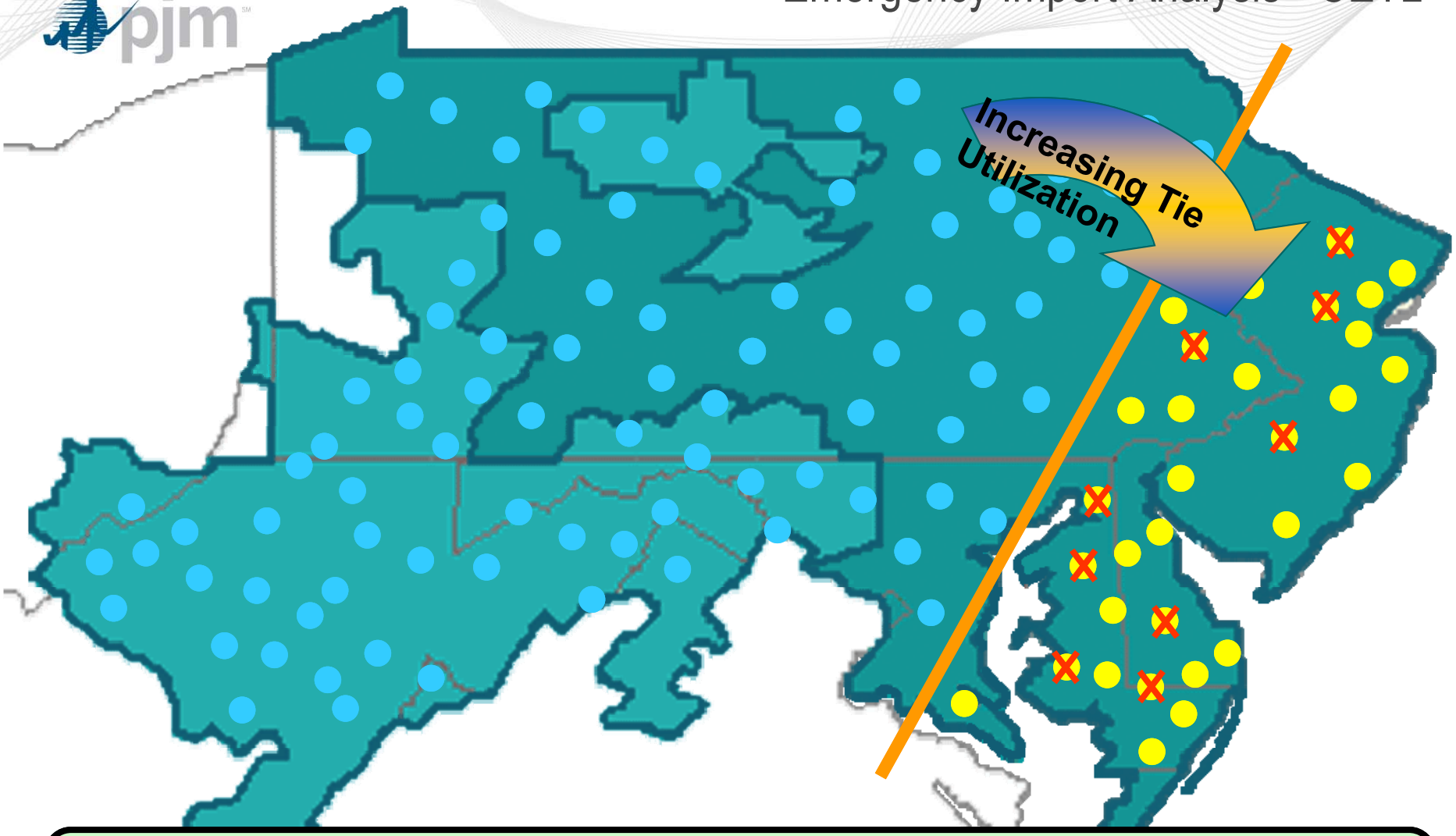
Emergency Import Analysis - CETO



Load Deliverability Area (LDA) at Forecast Peak, served by Internal Generation and increasing imports.

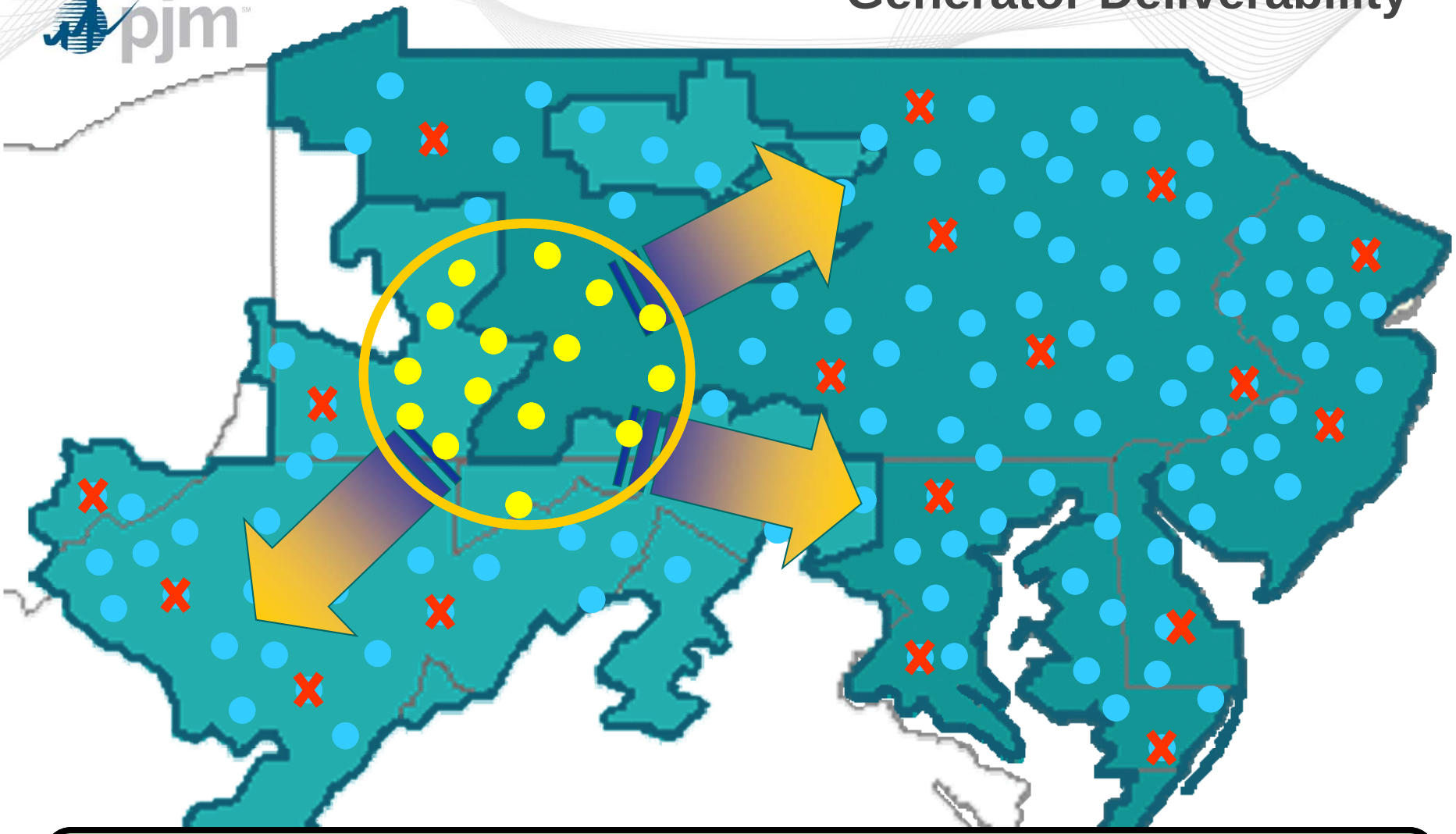
- CETL studies examine the ability of the transmission system to support deliveries of capacity into an LDA experiencing a capacity emergency at high (90/10) load.
- Generating resources are removed from service to create a need to import capacity into the LDA.
- CETL is the maximum import capability which does not overload transmission or cause low voltages in the LDA.
- If CETL > CETO, the LDA passes the test; imports can cover the need.

Emergency Import Analysis - CETL



Load Deliverability Area (LDA) at 90/10 load, served by decreasing Internal Generation. Generation removed consistent with units' past performance.

Generator Deliverability

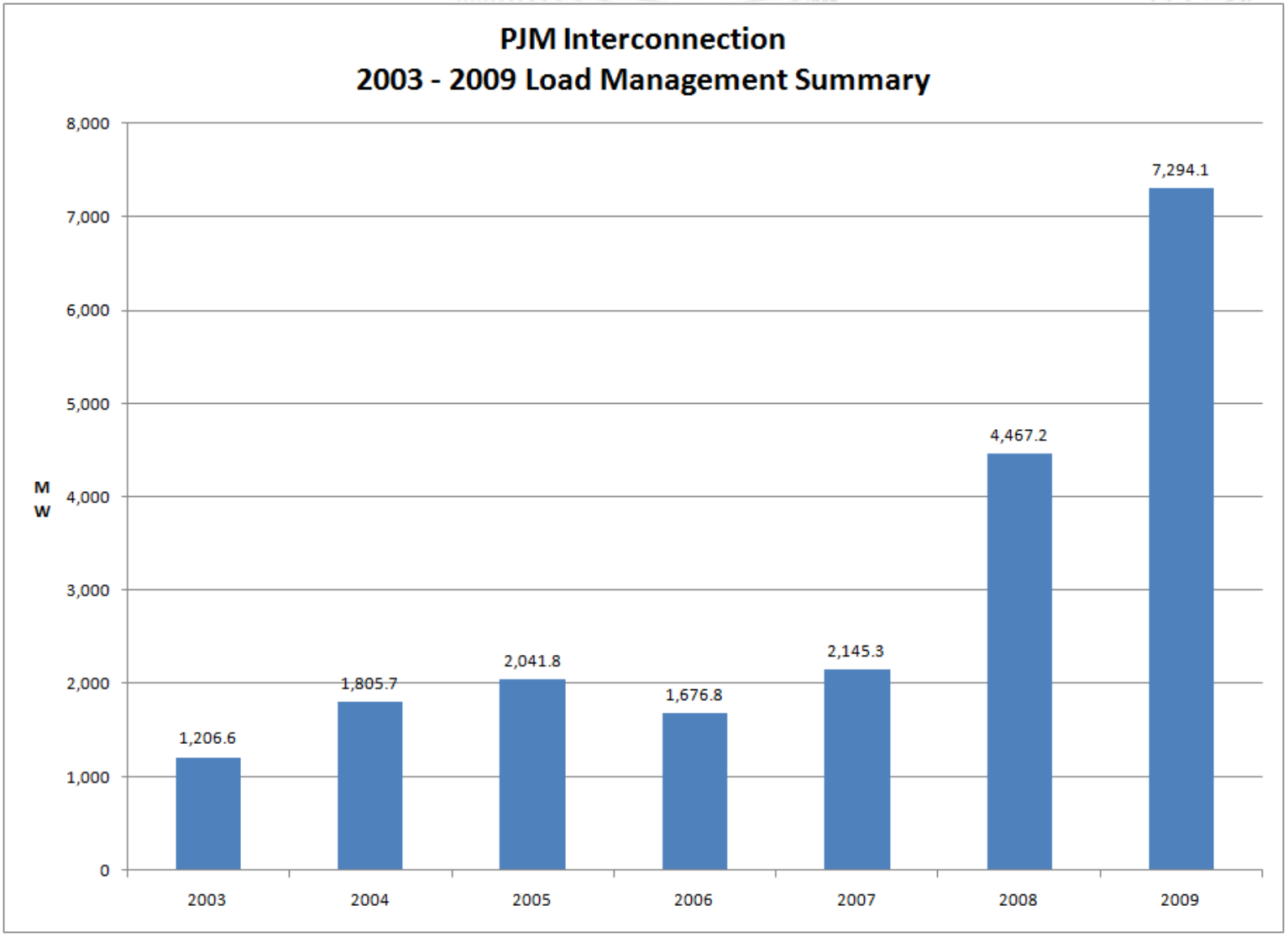


Strength of the transmission system to ensure that the aggregate of generators in a given area can be reliably transferred to the rest of PJM.

- Load Management
  - Interruptible Load for Reliability (a.k.a. ILR)
  - Demand Resource (DR)
- Distributed Generation
  - Typically smaller resources
  - Behind the meter generation
- Energy Efficiency
  - Traditionally incorporated as an offset to historical load
  - Included in RPM for the first time for the 2012/13 Delivery Year (570 MW cleared)

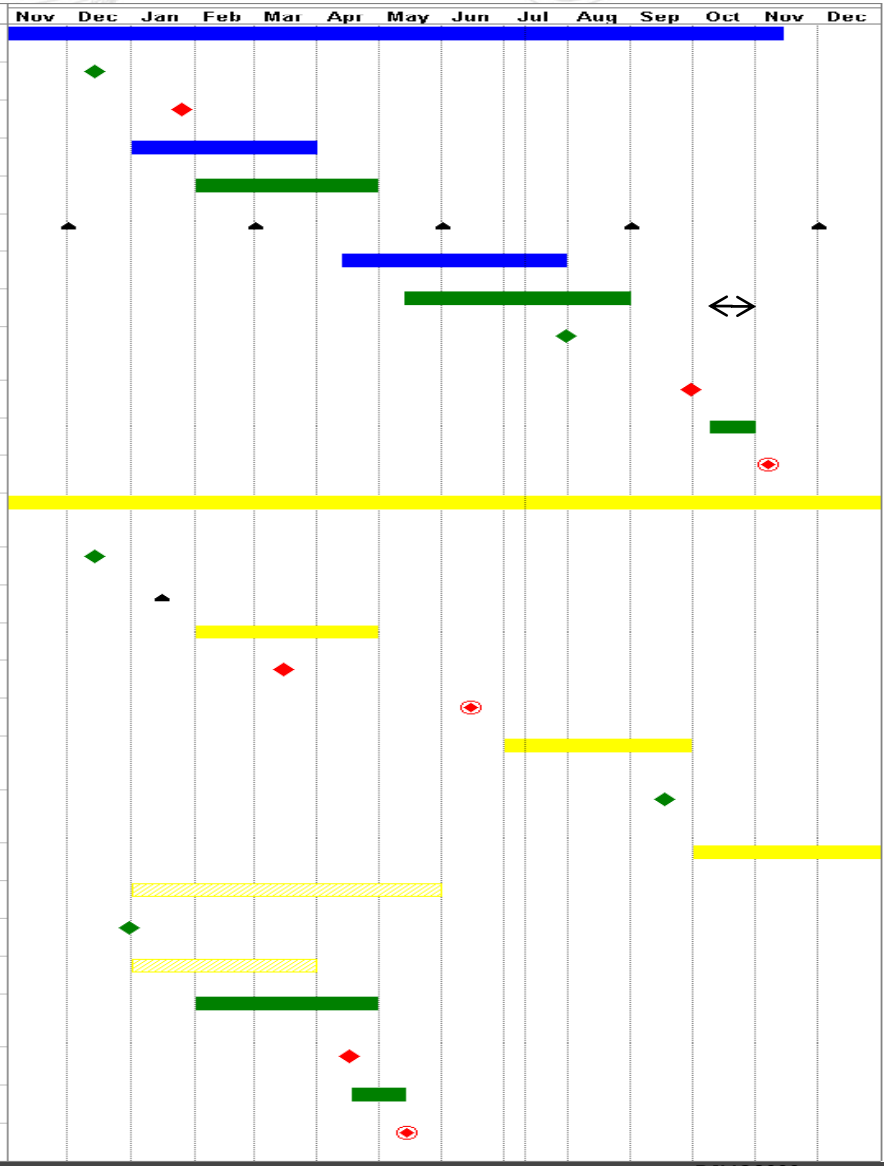
- Load Management
  - Utilized for PJM load deliverability testing.
  - Assume load management programs have been implemented in the area under study
- Distributed Generation
  - Can come in on the supply side through load management programs or as reduced load in load forecast
- Energy Efficiency
  - Incorporated into the RTEP as part of the load forecast to the extent that it is reflected in historic load data.
  - EE cleared in RPM will be explicitly incorporated into future load forecasts

Trends in Distributed Resources



RTEP Timeline

ID	Task Name
1	**RELIABILITY PLANNING**
2	Subregional RTEP Committee initial assumptions meeting
3	TEAC review/input: realibility assumptions
4	PJM analysis: near-term reliability
5	PJM-stakeholder communication & reviews: ongoing
6	[Quarterly Queue Impact Study Start Dates]
12	PJM analysis: long-term thermal & reactive reliability
13	PJM-stakeholder communication & reviews: ongoing
14	Subregional RTEP Committee review/input: violations & upgrades
15	TEAC review/input: reliability violations & upgrades
16	Post TEAC meeting comment period
17	BOM review & approval: RTEP reliability plan
18	**MARKET EFFICIENCY PLANNING (current RTEP year) (monthly posting of historical congestion drivers)**
19	Subregional RTEP Committee initial assumptions meeting
20	[PJM entity forecast available]
21	PJM: Market efficiency assumptions development
22	TEAC review/input: market efficiency assumptions
23	BOM review and approval: market efficiency assumptions
24	PJM analysis: historical congestion, projection of congestion & conceptual solutions
25	TEAC or Subregional RTEP Committee review/input: congestion drivers and conceptual solutons
26	PJM analysis: acceleration of reliability upgrades
27	**Market Efficiency Planning (previous RTEP year)**
28	Deadline: Stakeholder Market solutions
29	PJM analysis: new market efficiency solutions
30	TEAC or Subregional RTEP Committee review/input: market efficiency solutions
31	TEAC review/input: market efficiency solutions and analyses
32	Post TEAC meeting comment period
33	BOM review and approval: RTEP market efficiency plan



Questions?