



Cigre Large Load Webinar

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- The unprecedented growth in electric demand over the next decade associated with large loads provides PJM with a unique opportunity to support economic development and be part of the solution.
- The PJM region is an attractive area for large loads to integrate because of its location, size, market opportunities, and reliable system.
- PJM recognizes the national importance and need to integrate these large loads efficiently and reliably.
- This webinar will address some of the benefits and challenges of the significant large load growth in the PJM region to include technical, economic, political, infrastructure, and resource adequacy.

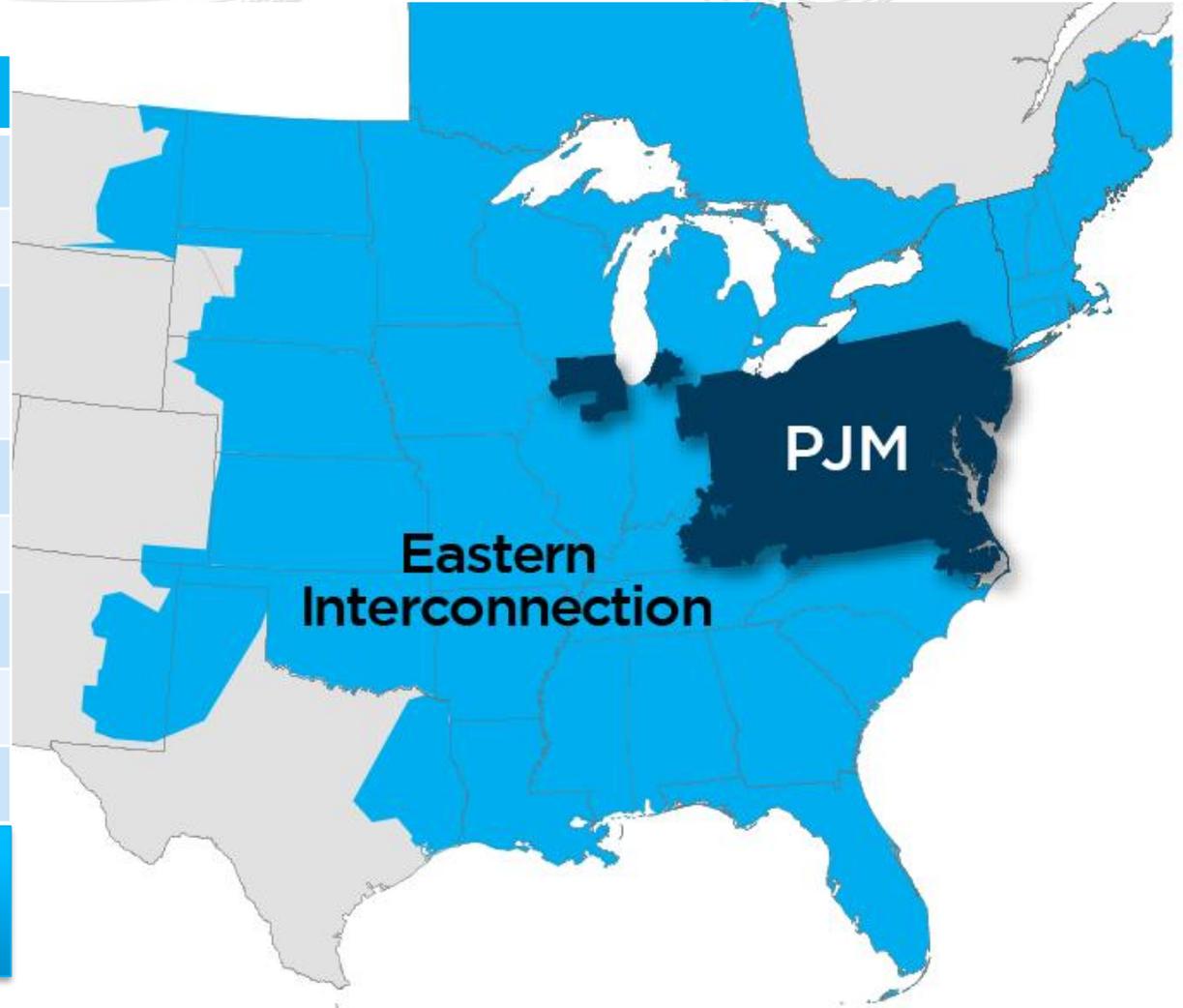


PJM and its role

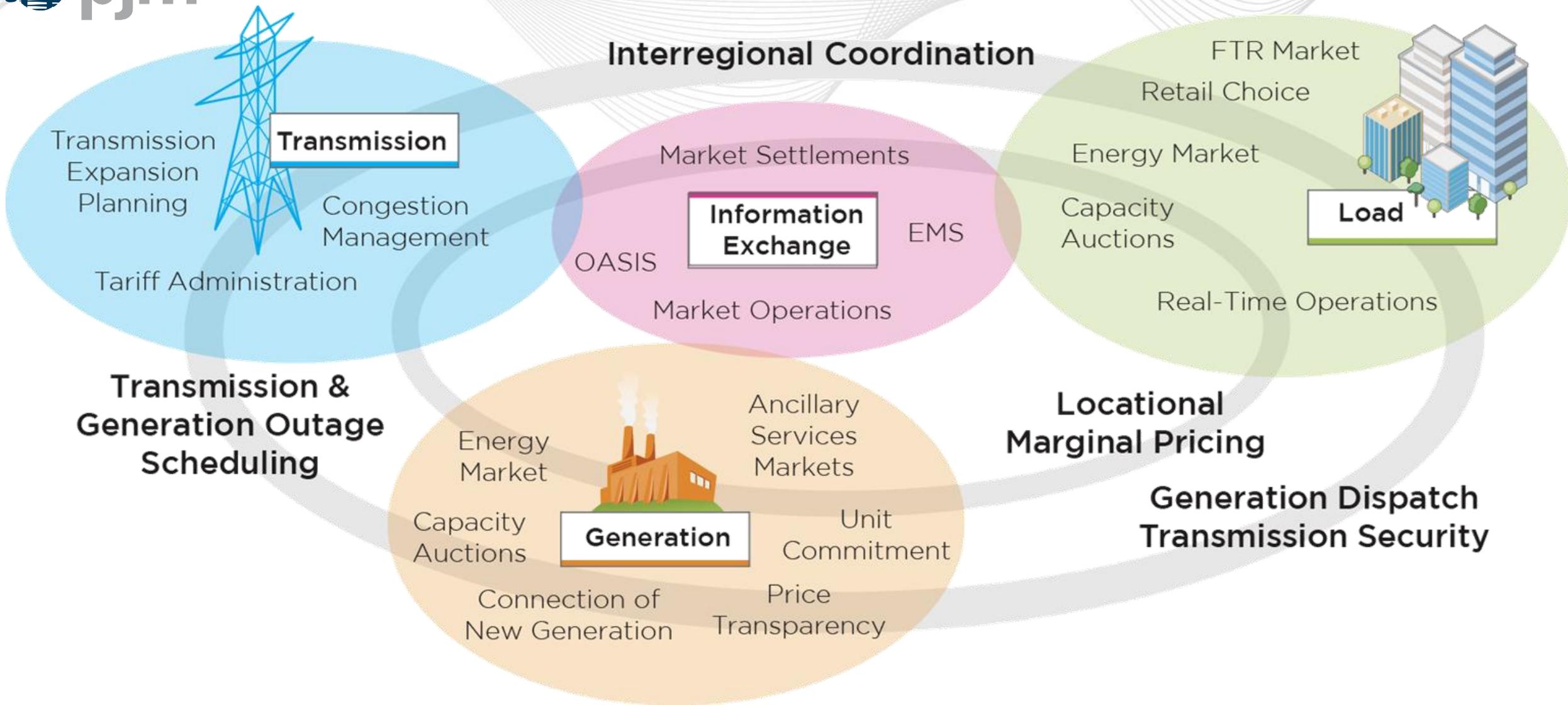
Key Statistics

Member companies	1,110
Millions of people served	67+
Peak load in megawatts	165,563
Megawatts of generating capacity	182,036
Miles of transmission lines (BES)	88,333
Gigawatt hours of annual energy	800,004
Generation sources	1,486
Square miles of territory	369,054
States served	13 + DC

- 27% of generation in Eastern Interconnection
- 24% of load in Eastern Interconnection



As of 2/2025



How Is PJM Different from Other Utility Companies?

PJM Does:

- Direct operation of the transmission system
- Remain profit-neutral
- Maintain independence from PJM members
- Coordinate maintenance of grid facilities

PJM Does *NOT*:

- Own any transmission or generation assets
- Function as a publicly traded company with shareholders and concerns around “earnings”
- Perform maintenance on generators or transmission systems (e.g., repair power lines)
- Serve or direct any end-use customers (retail)

PJM
Open Access
Transmission
Tariff (OATT)

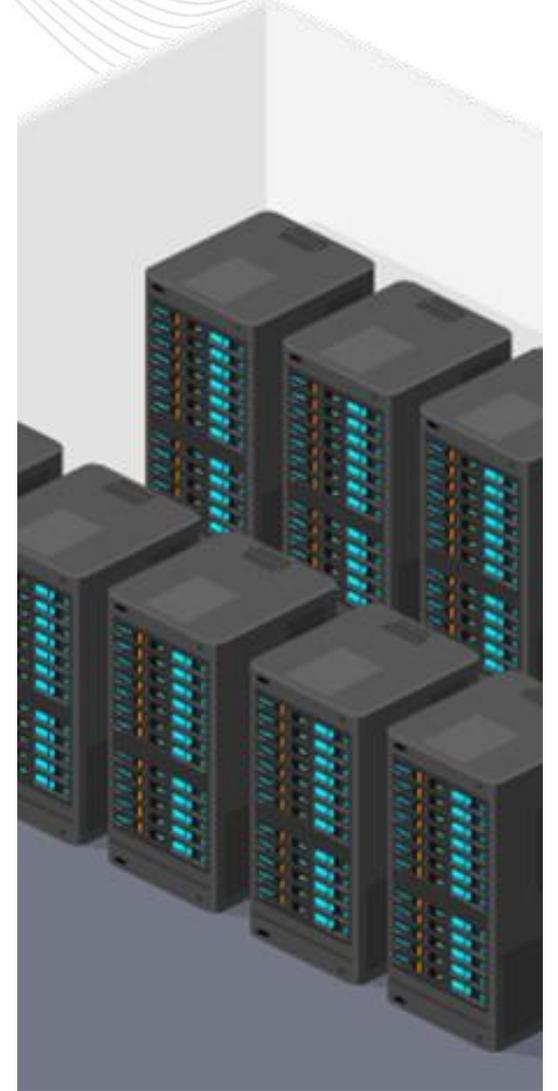
Reliability
Assurance
Agreement

Transmission
Owner (TO)
Agreement

PJM
Operating
Agreement

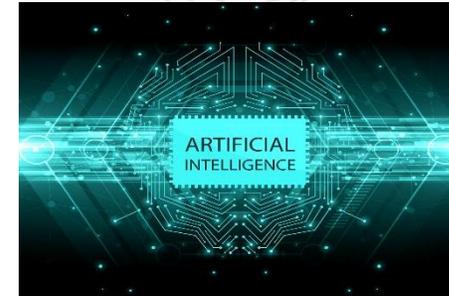
Large Loads

- The unprecedented growth in electric demand over the next decade associated with large loads provides PJM with a unique opportunity to support economic development and be part of the solution.
- The PJM region is an attractive area for large loads to integrate because of its location, size, market opportunities, and reliable system.
- PJM recognizes the national importance and need to integrate these large loads efficiently and reliably.



1. Economic Growth

- Creation of jobs
- Attract investments



2. Technological Leadership

- Maintain competitive edge in technology and innovation



3. Infrastructure Development

- Upgrades to grid infrastructure



4. National Security

Traditional (enterprise) data centers have a long history of participating in PJM's markets as capacity-only resources and represent ~3% of DR capacity megawatts today.

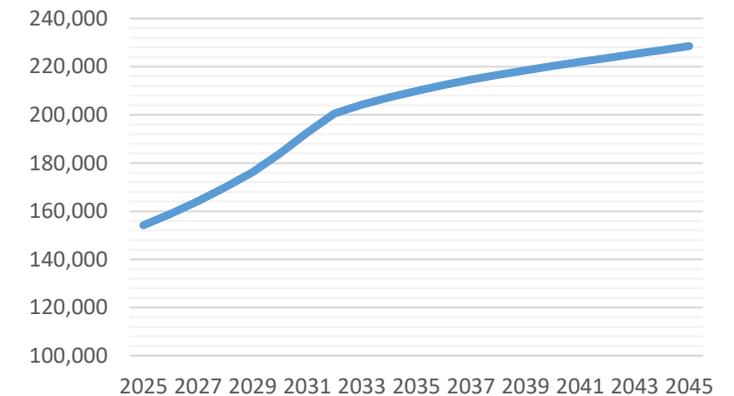
Very large (hyperscale) data centers – the largest facilities have no history of participating in the wholesale market.

Hyperscalers have so far been **hesitant in exploring market participation pathways**, indicating to PJM that the risk of interruptions, especially for customer-facing processes, far exceeds any economic value of participation under current incentives/markets.



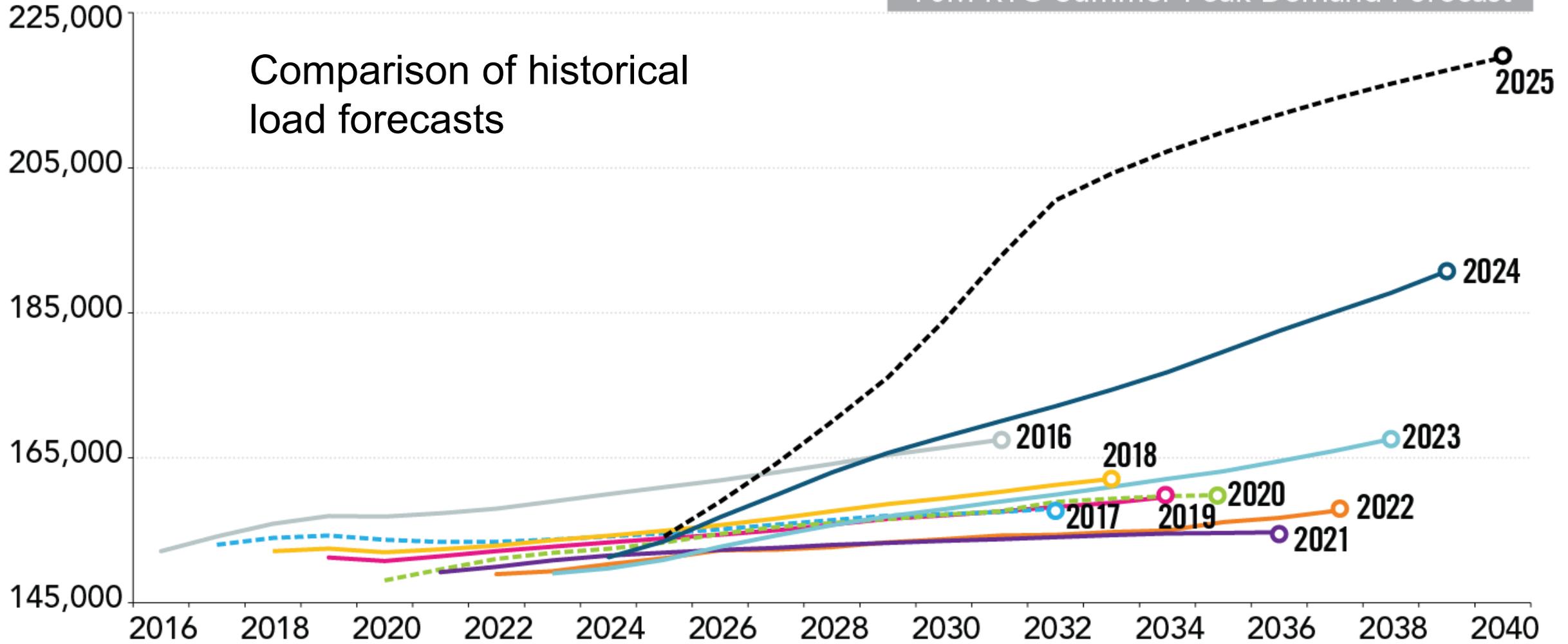
1. Forecasted supply may not be sufficient to meet the forecasted load.
2. The pace of forecasted load growth combined with anticipated resource retirements presents timing challenges for needed investment.
 - Transition mechanisms may be needed to support resource adequacy
3. Existing demand side products do not provide adequate incentives for large load participation.
 - Acquiring flexibility is challenging because large loads prefer to stay online.
 - Back-up diesel units cannot operate for long periods because of environmental restrictions.
4. Data centers' desired time to market creates the need for alternative mechanisms to connect to the grid
 - May seek co-located arrangements outside the market that are less reliable.

Forecasted Load (MW)
Summer Peak
(2025 Report)

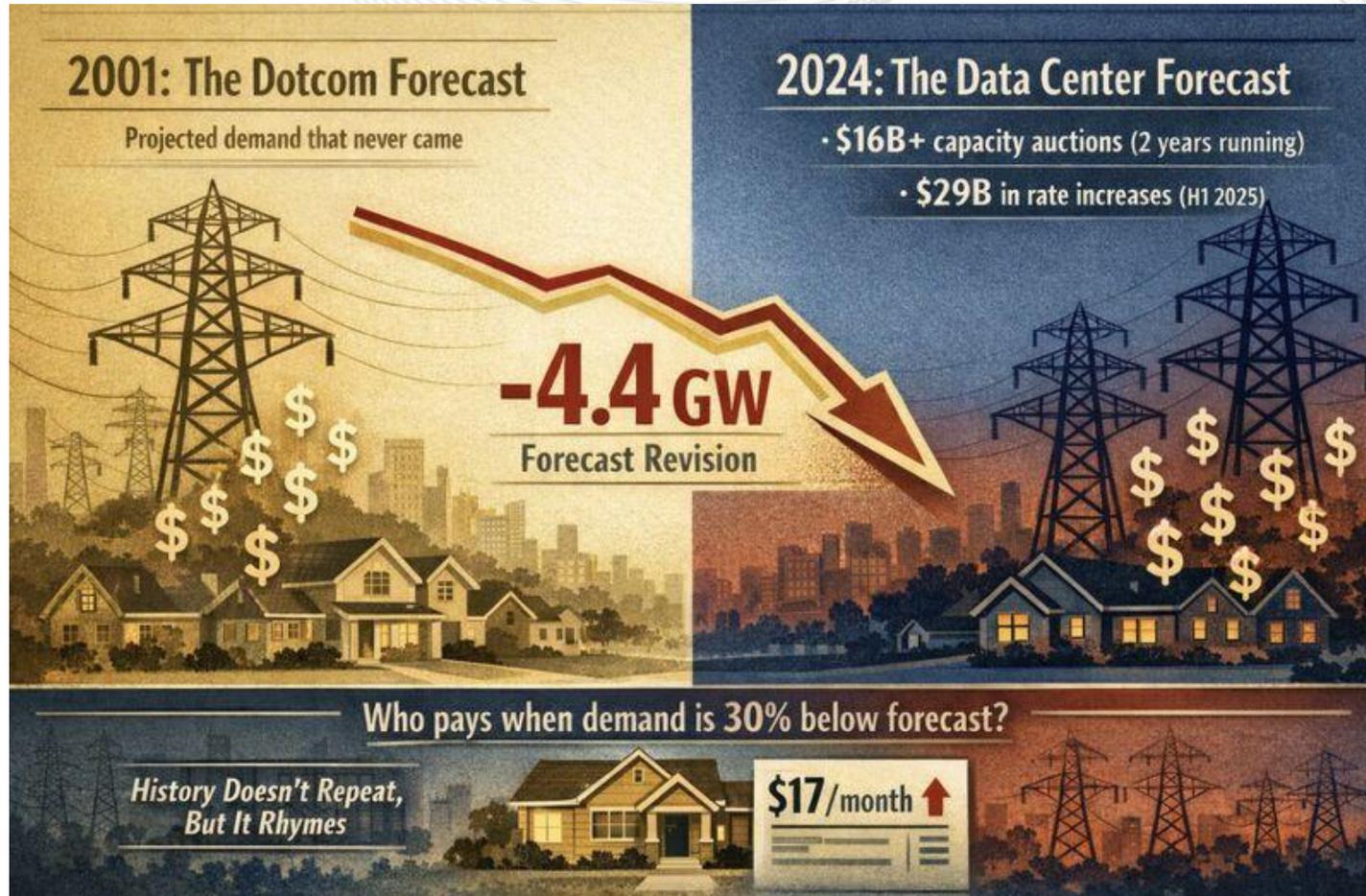


PJM RTO Summer Peak Demand Forecast

Load (MW)



Too low...
Reliability issues



High...
Stranded costs

https://www.linkedin.com/posts/david-bohn_the-person-who-ends-up-with-bill-is-always-activity-7430769212412817408-rvsp

- Significant new data center load growth
- Transmission infrastructure needed to accommodate the load growth
- Resource adequacy resources – generation, storage, demand products needed to serve the load growth



Economic Development
Opportunities



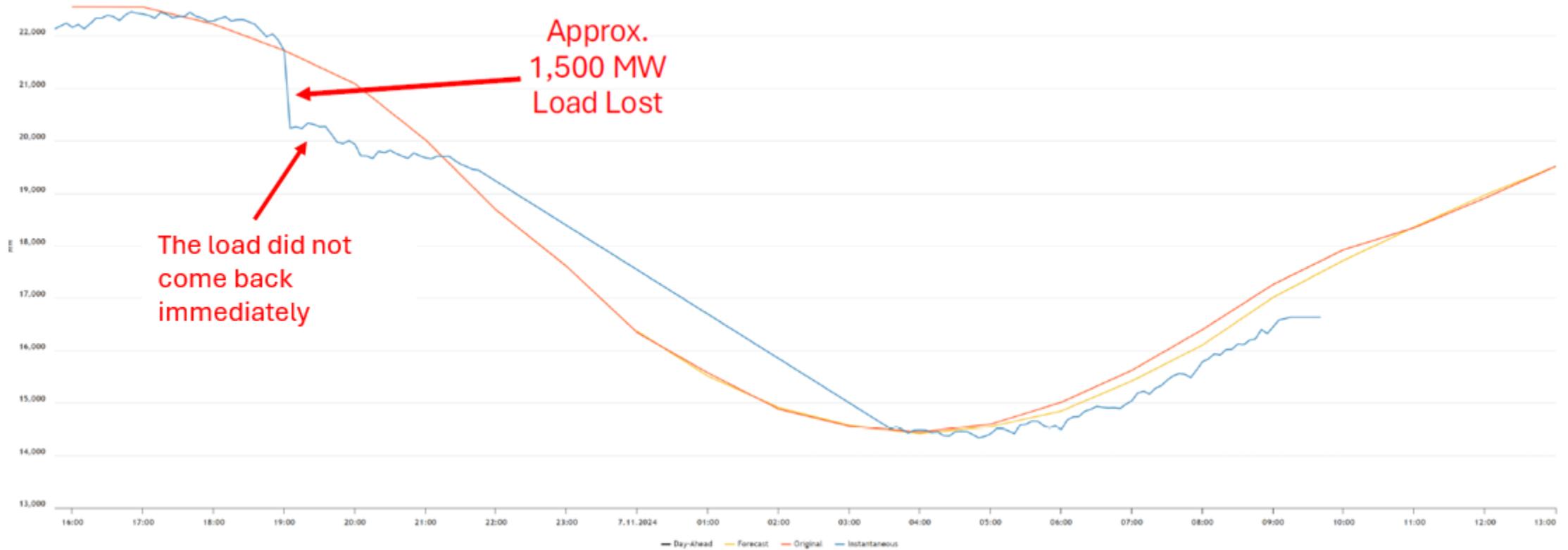
Electricity rate impact to
consumers

Reliability Impacts

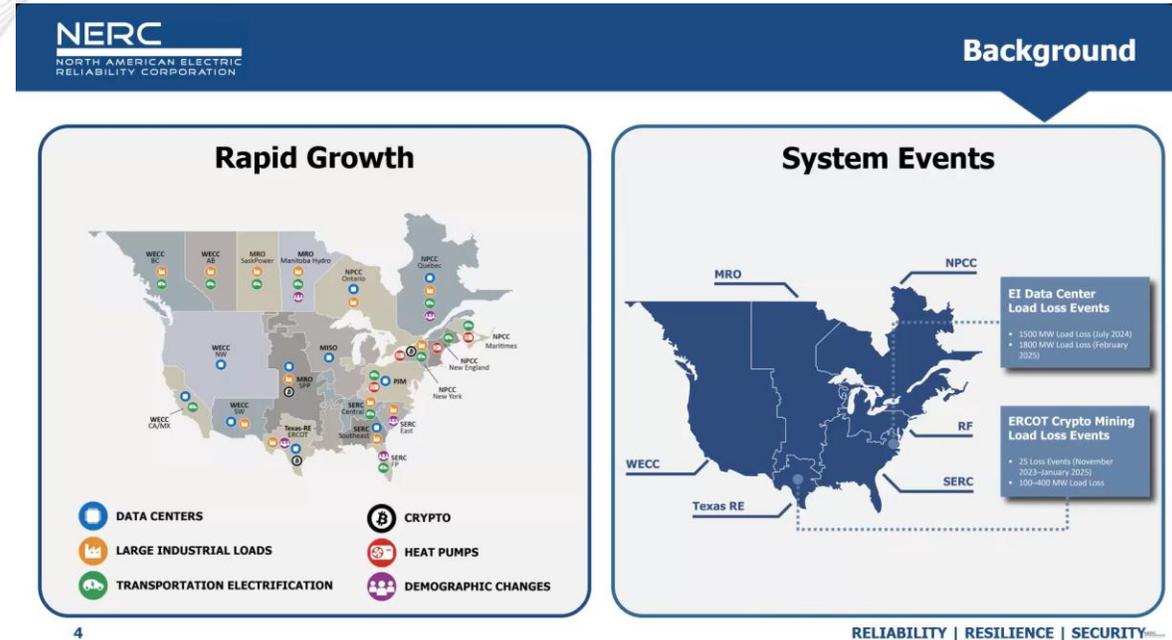
Considering Simultaneous Voltage-Sensitive Load Reductions

- A 230 kV transmission line fault led to customer-initiated simultaneous loss of approximately 1,500 MW of voltage-sensitive load that was not anticipated by the BES operators.
- The electric grid has not historically experienced simultaneous load losses of this magnitude in response to a fault on the system, which has historically been planned for large generation losses but not for such significant simultaneous load losses.
- Simultaneous large load losses have two effects on the electric system: First, frequency rises on the system as a result of the imbalance between load and generation; second, voltage rises rapidly because less power is flowing through the system.
- In this incident, the frequency did not rise to a level high enough to cause concern. The voltage also did not rise to levels that posed a reliability risk, but operators did have to take action to reduce the voltage to within normal operating levels.

- At approximately 7:00 p.m. Eastern on July 10, 2024, a lightning arrester failed on a 230 kV transmission line in the Eastern Interconnection, resulting in a permanent fault that eventually “locked out” the transmission line.
- The auto-reclosing control on the transmission line was configured for three auto-reclose attempts staggered at each end of the line. This configuration resulted in 6 successive system faults in an 82-second period.
- The protection system detected these faults and cleared them properly. The shortest fault duration was the initial fault at 42 milliseconds, and the longest fault duration was 66 milliseconds.
- The voltage magnitudes during the fault ranged from .25 to .40 per unit in the load-loss area.



- NERC analyzed a series of disturbances that occurred on the bulk power system resulting in widespread and unexpected customer-initiated load reduction of large loads.
- These disturbances involved multiple events during which 1,000+ MW of unexpected Large Loads output reduction occurred, with most events occurring in 2024 or 2025.
- The increase of Large Loads-related events coincides with an increase in Large Load penetration across the system.
- Rapid, major swings in load, experienced both in typical operations as well as in response to grid disturbances, can impact the BPS's ability to maintain frequency, regulate transmission voltage and otherwise maintain stability.
- 20-page data request to assess the state of the industry



<https://www.nerc.com/globalassets/programs/bpsa/alerts/2025/nerc-alert-level-2--large-loads.pdf>

- Require dynamic response models of large loads in their facility interconnection requirements
- Perform studies to determine the potential magnitude of load loss for system disturbances (faults)
 - Study the impact that these large load losses would have on the system
- Take into consideration the potential for voltage-sensitive load loss when configuring automatic reclosing schemes
- Actively monitor to detect load losses coincident with system faults
- Transmission Operators - ensure that operating agreements with large loads include ramp rates when connecting/reconnecting large loads to the system

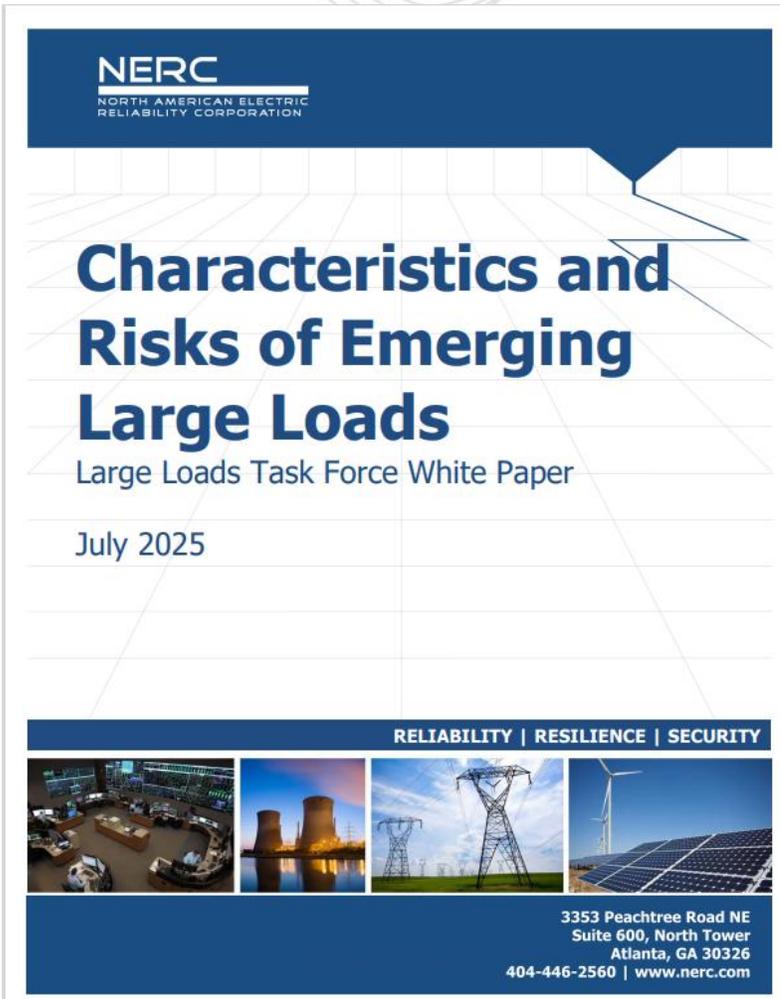
Excerpts...

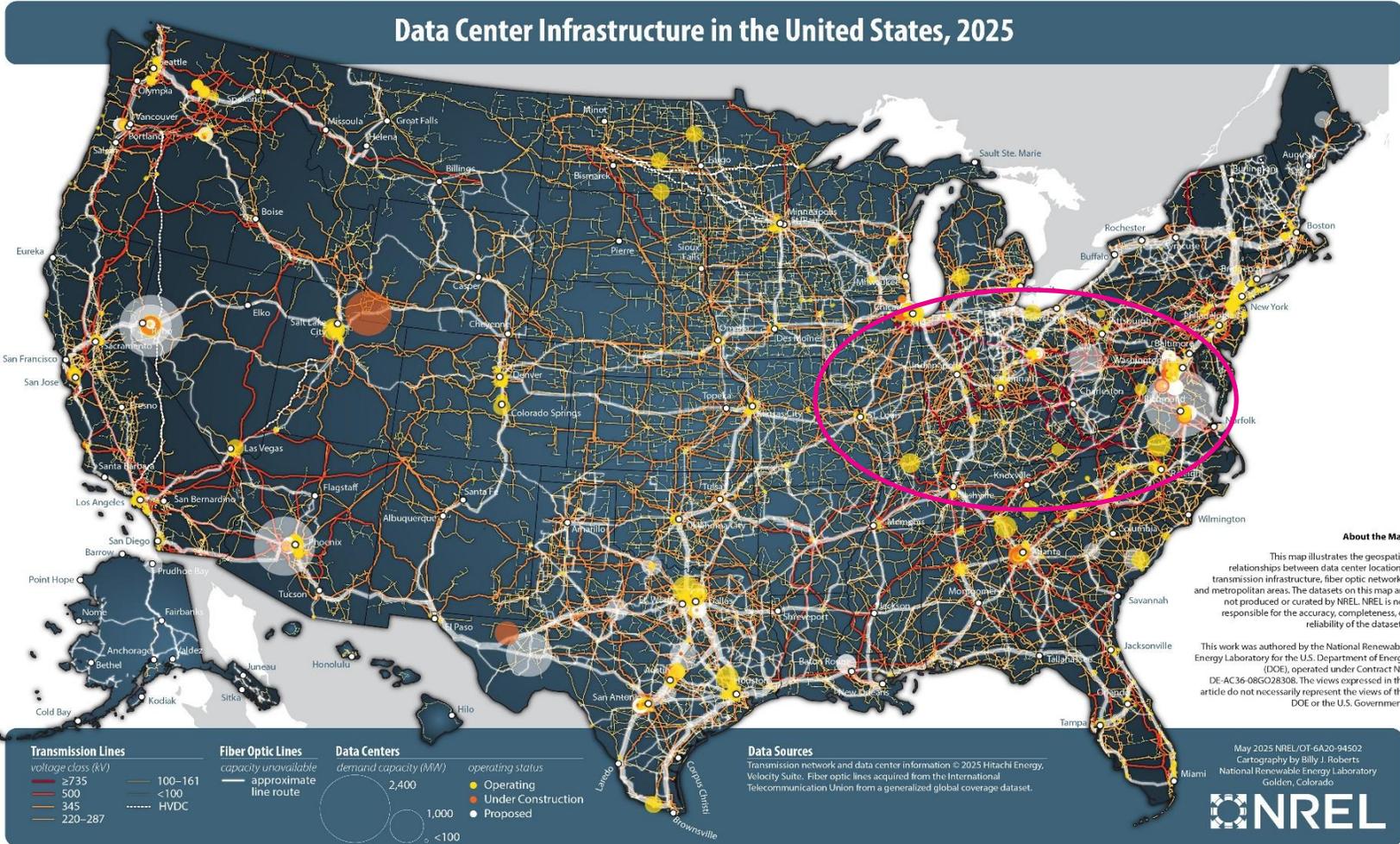
- Participation in system-wide Under-Frequency Load Shedding (UFLS) programs is a requirement for all applicable Customers.
- Customer facility must be designed and operated to prevent any adverse or unstable interactions with the transmission network or the control systems of other interconnected facilities, such as generators, FACTS devices, neighboring IBRs, or other loads
- Facilities must be designed and operated to minimize any significant signal injections into the transmission system within critical frequency bands
- Ride through requirements
- Power Quality requirements

<https://www.dominionenergy.com/-/media/content/large-business-services/pdfs/virginia/facility-interconnection-requirements.pdf>

Government and NGOs

- Identify existing processes and standards that do not fully address the risks of emerging large loads
- Identify potential mitigations to risks posed by emerging large loads through improvements to existing planning and operation processes and interconnection procedures for large
- Define each of the identified characteristics of emerging large loads and develop a framework for classifying large loads.
- Create and approve load models that can show the characteristics and risks of each category of emerging large loads in simulations.
- Assess possible protection system impacts to the BPS from emerging large loads.
- Investigate methods for grid operators and planners to assess the risks potentially posed by emerging large loads to resource adequacy.







Workstream 1. Grid-Informed Flexible Data Center Designs

Enabling future data centers to become grid resources through flexible & efficient designs and operational practices

[Learn More](#)



Workstream 3. Grid Planning for Operational Flexibility

Equipping the utility industry planning practices to embrace large flexible loads

[Learn More](#)



Workstream 2. Transformational Utility Programs

Exploring market and program structures that advance data center flexibility

[Learn More](#)



Workstream 4. Data Center Informed Energy Supply

Guiding the development of energy supply resource development

[Learn More](#)



Workstream 5. Distribution-Connected Data Centers

Understanding and enabling distribution-connected data centers (DxDCs)

[Learn More](#)

- Federal Energy Regulatory Commission (FERC)
 - Co-located load order
- Department of Energy (DOE)
 - Emergency Orders
 - Supply Chain
- US Whitehouse Office of Energy (OED)
 - Siting and building large loads
 - resource adequacy (quick) solutions