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NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

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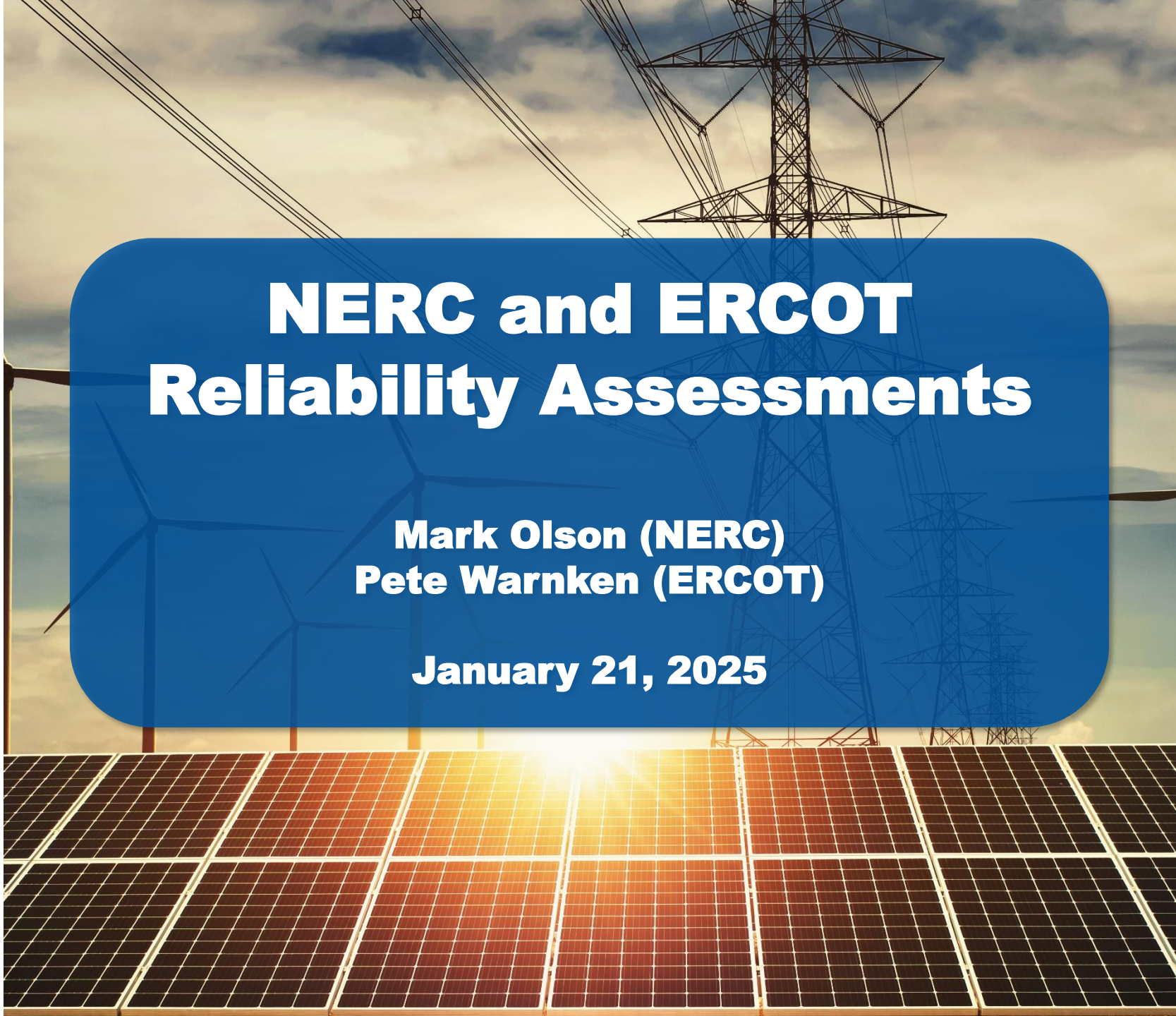

NERC and ERCOT Reliability Assessments

Mark Olson (NERC)
Pete Warnken (ERCOT)

January 21, 2025

Antitrust Admonition

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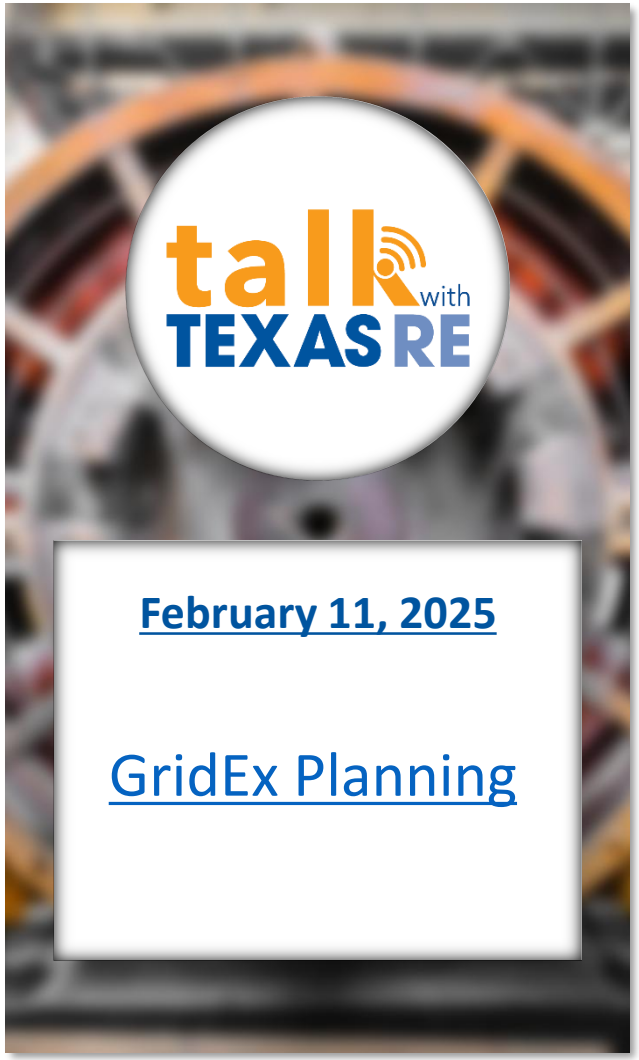
Notice of this meeting was posted on the Texas RE website and this meeting is being held in public. Participants should keep in mind that the listening audience may include members of the press, representatives from various governmental authorities, and industry stakeholders.

Upcoming Texas RE Events

January 29, 2025

Interregional Transfer Capability Study



February 11, 2025

GridEx Planning

April 23, 2025

Spring Standards, Security, & Reliability Workshop

Upcoming ERO Enterprise Events

Date	Event
January 22	Open Source Reconnaissance in the Electric Sector Webinar (MRO)
January 23	2024-2026 Regional Risk Report Webinar (SERC)
January 23	LTRA Webinar (MRO)
February 4	Penetration-Testing Webinar (MRO)
February 10	Technical Talk with RF (RF)
February 25-26	Spring Reliability & Security Seminar (SERC)
March 4	2025 Women's Leadership Conference (MRO)

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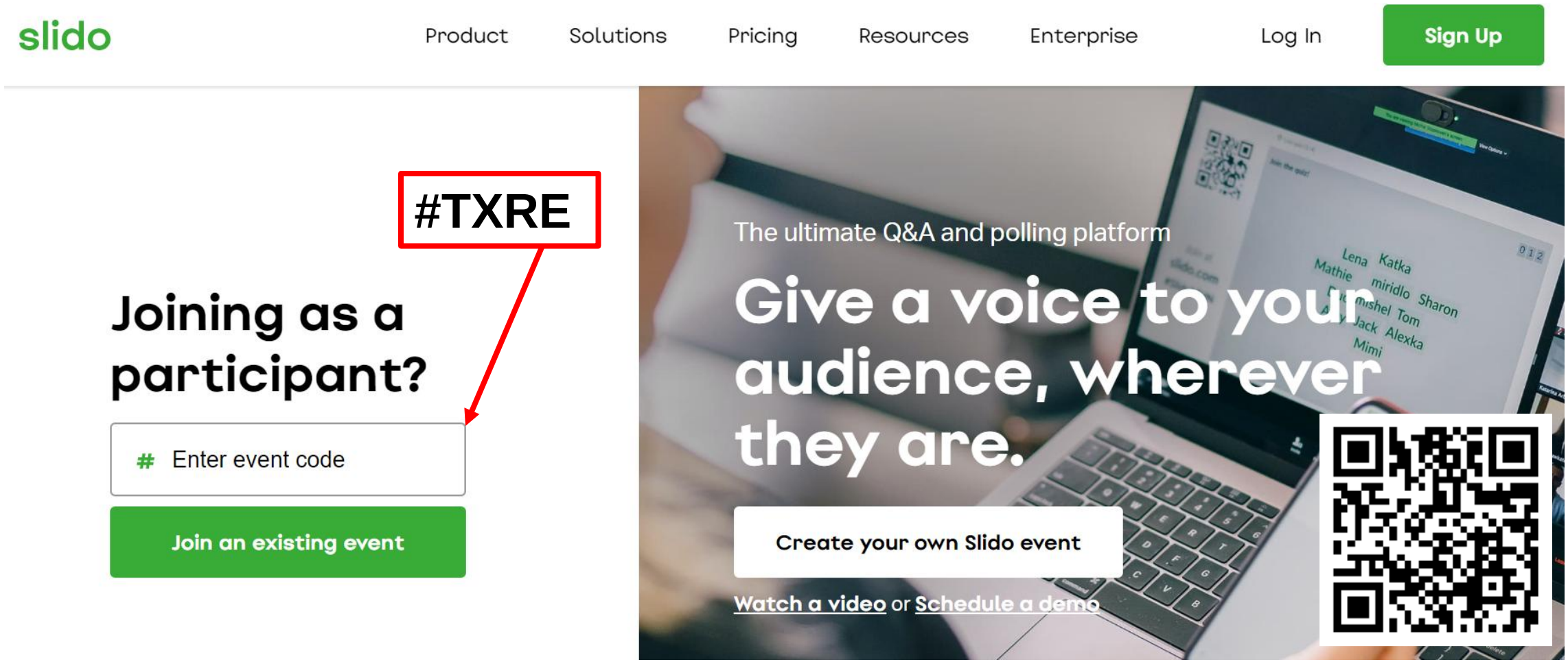
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Texas Reliability Entity Inc.
“Talk with Texas”

ERCOT Resource Adequacy Reports Overview

Pete Warnken
ERCOT Resource Adequacy Manager

January 21, 2025

February and March MORA Probabilistic Results

Probabilistic modeling results indicate a low risk of having to declare an Energy Emergency Alert (EEA) for February and March. Highest risk hours transition from the morning in February to the early evening hours in March (Hour Ending 7 p.m. and 8 p.m.)

February

Hour Ending (CST)	Chance of Normal System Conditions	EMERGENCY LEVEL	
		Chance of an Energy Emergency Alert	Chance of Ordering Controlled Outages
	Probability of CAFOR being above 3,000 MW	Probability of CAFOR being less than 2,500 MW	Probability of CAFOR being less than 1,500 MW
1 a.m.	99.62%	0.25%	0.17%
2 a.m.	99.77%	0.07%	0.04%
3 a.m.	99.55%	0.21%	0.12%
4 a.m.	99.57%	0.24%	0.13%
5 a.m.	99.53%	0.23%	0.13%
6 a.m.	99.65%	0.21%	0.15%
7 a.m.	97.85%	1.03%	0.76%
8 a.m.	94.56%	2.14%	1.58%
9 a.m.	98.07%	0.69%	0.47%
10 a.m.	99.35%	0.32%	0.23%
11 a.m.	99.86%	0.05%	0.03%
12 p.m.	99.98%	0.01%	0.01%
1 p.m.	99.99%	0.00%	0.00%
2 p.m.	100.00%	0.00%	0.00%
3 p.m.	100.00%	0.00%	0.00%
4 p.m.	99.98%	0.01%	0.00%
5 p.m.	99.99%	0.00%	0.00%
6 p.m.	99.99%	0.00%	0.00%
7 p.m.	99.94%	0.02%	0.02%
8 p.m.	99.81%	0.05%	0.04%
9 p.m.	99.66%	0.15%	0.10%
10 p.m.	99.90%	0.04%	0.03%
11 p.m.	99.96%	0.00%	0.00%
12 a.m.	99.99%	0.00%	0.00%

Note: Probabilities are not additive.

March

Hour Ending (CST)	Chance of Normal System Conditions	EMERGENCY LEVEL	
		Chance of an Energy Emergency Alert	Chance of Ordering Controlled Outages
	Probability of CAFOR being above 3,000 MW	Probability of CAFOR being less than 2,500 MW	Probability of CAFOR being less than 1,500 MW
1 a.m.	99.33%	0.26%	0.19%
2 a.m.	99.16%	0.31%	0.15%
3 a.m.	99.18%	0.31%	0.19%
4 a.m.	99.38%	0.21%	0.13%
5 a.m.	98.79%	0.54%	0.40%
6 a.m.	98.23%	0.73%	0.57%
7 a.m.	95.97%	2.25%	1.75%
8 a.m.	95.56%	2.61%	1.97%
9 a.m.	98.49%	0.83%	0.57%
10 a.m.	99.57%	0.19%	0.15%
11 a.m.	99.95%	0.03%	0.00%
12 p.m.	99.92%	0.03%	0.02%
1 p.m.	99.89%	0.04%	0.03%
2 p.m.	99.88%	0.04%	0.04%
3 p.m.	99.77%	0.11%	0.07%
4 p.m.	99.47%	0.27%	0.23%
5 p.m.	99.35%	0.30%	0.20%
6 p.m.	98.31%	0.82%	0.59%
7 p.m.	90.18%	6.31%	5.42%
8 p.m.	90.73%	6.21%	5.30%
9 p.m.	94.62%	3.34%	2.73%
10 p.m.	97.47%	1.44%	1.12%
11 p.m.	99.59%	0.11%	0.08%
12 a.m.	99.75%	0.04%	0.00%

Note: Probabilities are not additive.

Capacity, Demand and Reserves (CDR) Report

Significant Methodology Changes affecting the CDR (per NPRR1219)

- Shift to Effective Load Carrying Capabilities (ELCCs)
- Peak Net Load Information: Planning Reserve Margin and associated loads and resource information for the forecasted peak Net Load hour are being officially reported
- Updated Criteria for Planned Resources: The criteria for including planned resources in the CDR has been expanded to include the following:
  - ERCOT notification that a project developer has provided the required financial security for interconnection facility construction to the transmission provider
  - The transmission provider has received a notice to proceed with interconnection construction
- Inclusion of Publicly Announced Planned Retirements: A new category for planned retirements has been added to account for generation resources associated with publicly announced retirement plans, but their resource owners haven't yet submitted a formal Notification of Suspension of Operations (NSO) to ERCOT
- Inclusion of Distribution Voltage Reduction (DVR): Distribution voltage reduction is now included as a load-reducing adjustment to firm load forecasts

Effective Load Carrying Capabilities (ELCCs)

- For a system that meets a specific target reliability level, ELCCs express the expected reliability benefits of Inverter Based Resources during the hours with the highest risk of loss-of-load events
  - Derived through probabilistic simulations
  - Account for interactive effects with other IBRs and thermal resources
  - For Battery Energy Storage, account for the net load clipping ability of different design durations

Effective Load Carrying Capabilities				Historical Peak Average Capacity Factors (From May 2024 CDR)
Summer 2025				
Tech. Type	Afternoon	Evening		Peak Load Hour (Summer Avg)
Wind - Coastal	31%	16%		60%
Wind - Panhandle	34%	18%		29%
Wind - Other	16%	8%		22%
Solar - FarWest	36%	7%		76%
Solar - West	36%	7%		
Solar - Other	27%	6%		
Battery Energy Storage, by Design Duration				
1 hour	74%	74%		0%
2 hour	98%	98%		
3 hour	98%	98%		
4 hour	98%	98%		
5 hour	98%	98%		
6 hour	98%	98%		
7 hour	98%	98%		
8 hour	98%	98%		
9 hour	98%	98%		
10 hour	98%	98%		
11 hour	98%	98%		
12 hour	98%	98%		

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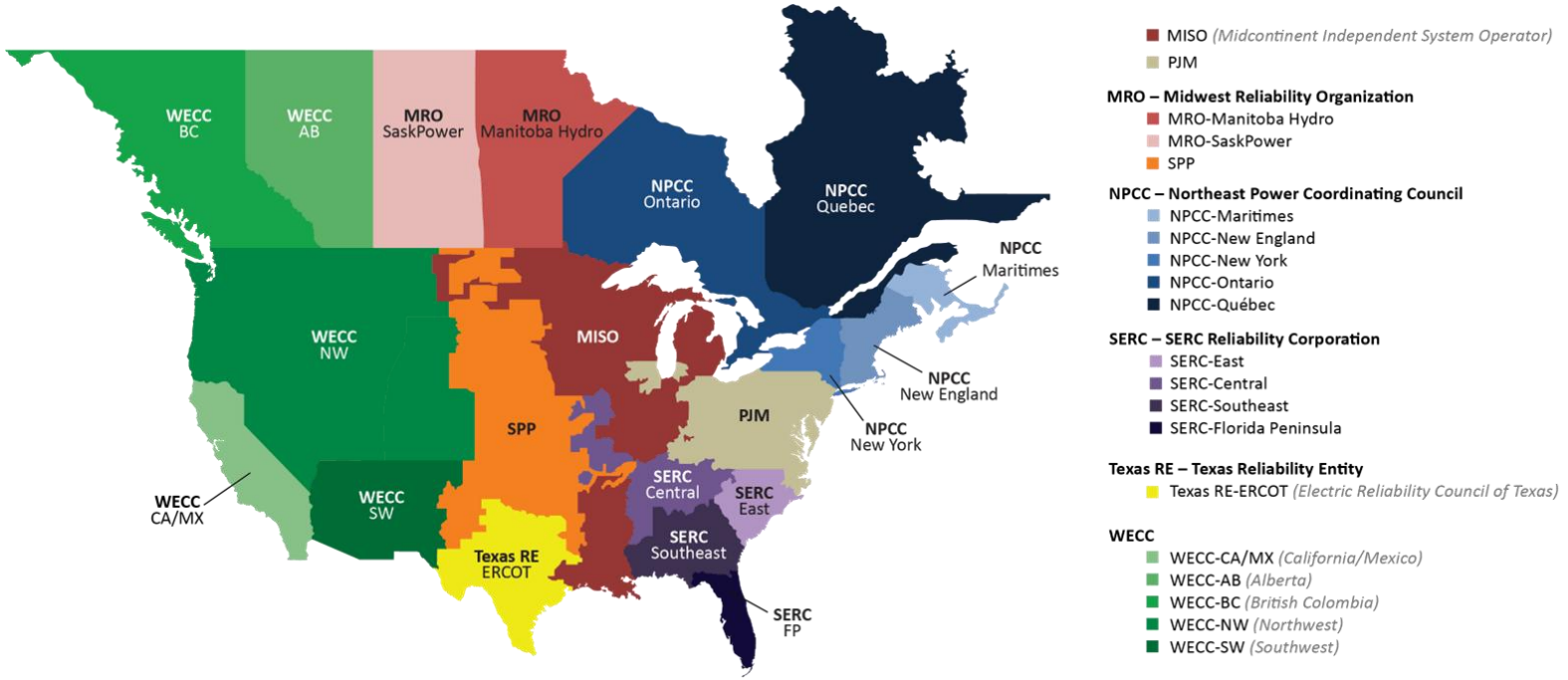
2024 Winter and Long-Term Reliability Assessments

Mark Olson, Manager, Reliability Assessment
Texas RE
January 21, 2025

Long-Term Reliability Assessment (LTRA)

- 10-year assessment of resource capacity and energy risks
- Uses industry's demand and generation forecasts and transmission projections
- Coordination and review with Region Entities and stakeholders
- Includes emerging issues that can impact future reliability



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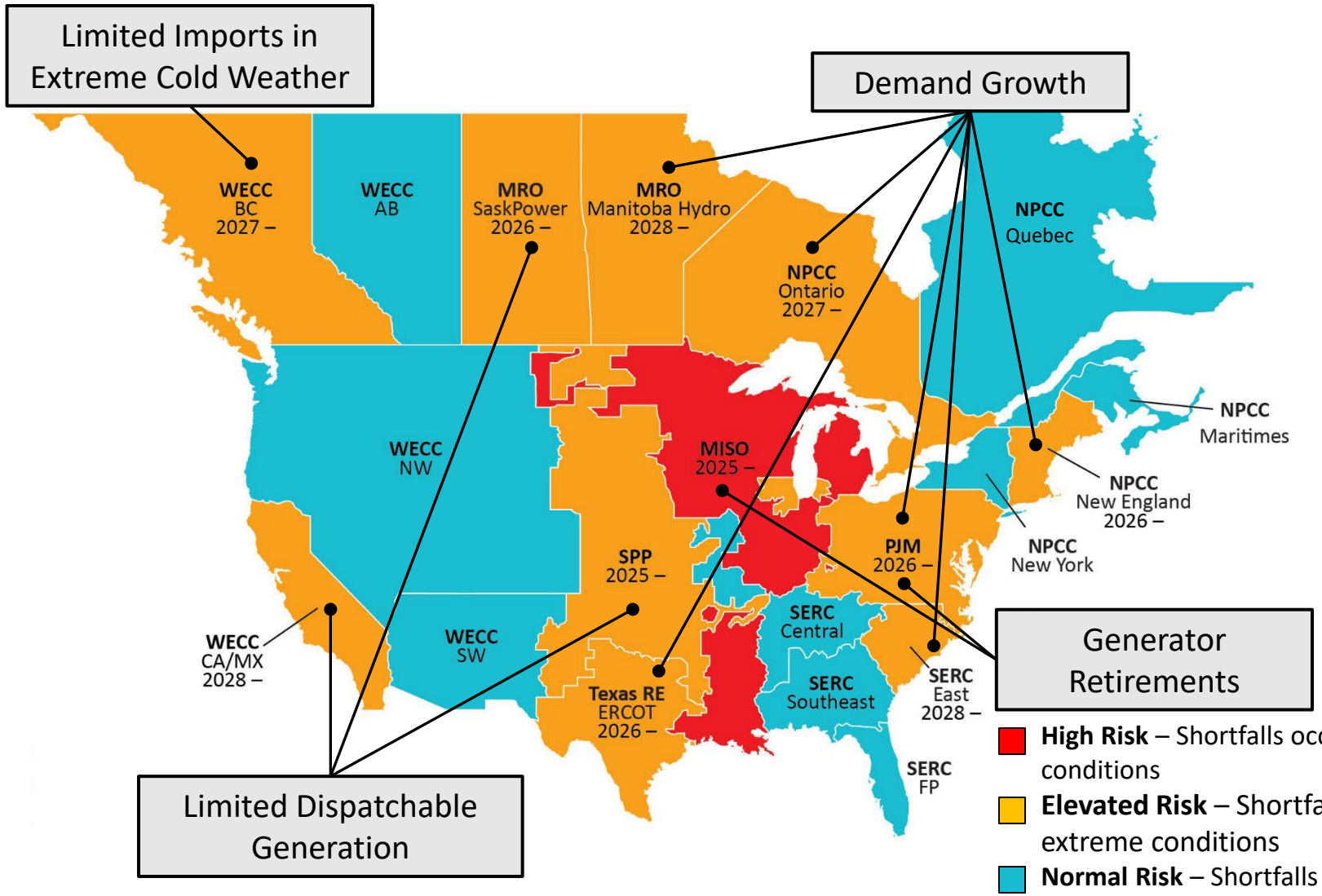
Key Findings

- **Assessment** Over half of North America is at risk of energy shortfalls over the next 10 years
- **Assessment** Projected generator retirements remain at high levels and accelerate the need for resources
- **Trend** Demand growth is rising rapidly driven by electrification, data centers, and industrial load
- **Trend** Projections of future resources reflect slower rate of additions
- **Trend** Transmission development is increasing, with more projects in planning

Increasing Energy Risks Over The Next 5 Years



Risk Map | with Risk Drivers and Initial Shortfall Years

High Risk – Shortfalls occurring in normal peak conditions

Elevated Risk – Shortfalls occurring in extreme conditions

Normal Risk – Shortfalls not expected under studied conditions

Assessment Inputs:

- Probabilistic Assessment (Studied Years 2026 and 2028)
- Planning Reserve Margins (2025 through 2029)

Risk determination based on established resource adequacy criteria (1-day-in-10 years) and NERC-National Academy of Engineering Workshop Report criteria for load-loss and unserved energy

Increasing Energy Shortfall Risks in Texas RE – ERCOT

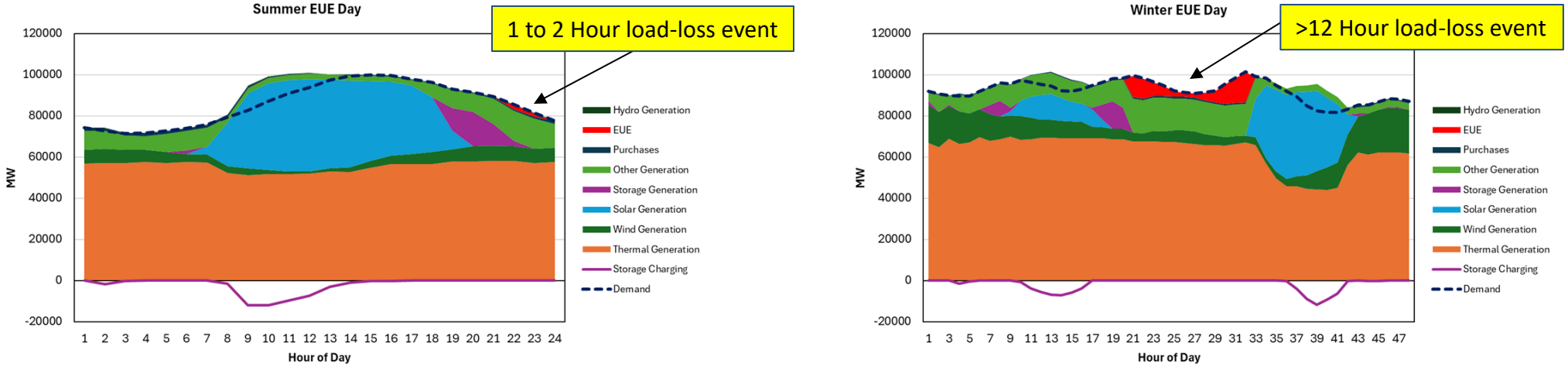
- Probabilistic assessment reveals higher levels of future unserved energy due to load growth projections and the characteristics of the resource mix

Base Case Summary of Results			
	2026*	2026	2028
EUE (MWh)	1,235	**11,090**	**781**
EUE (PPM)	2.63	**18.95**	**1.12**
LOLH (hours per year)	0.30	**1.57**	**0.16**
Operable On-Peak Margin	35.9%	**28.8%**	**46.9%**

* Provides the 2022 ProbA Results for Comparison

- *2026 study year shows increasing risk since previous ProbA*
- *2028 study year includes expansion resources from ERCOT Long-Term System Assessment*

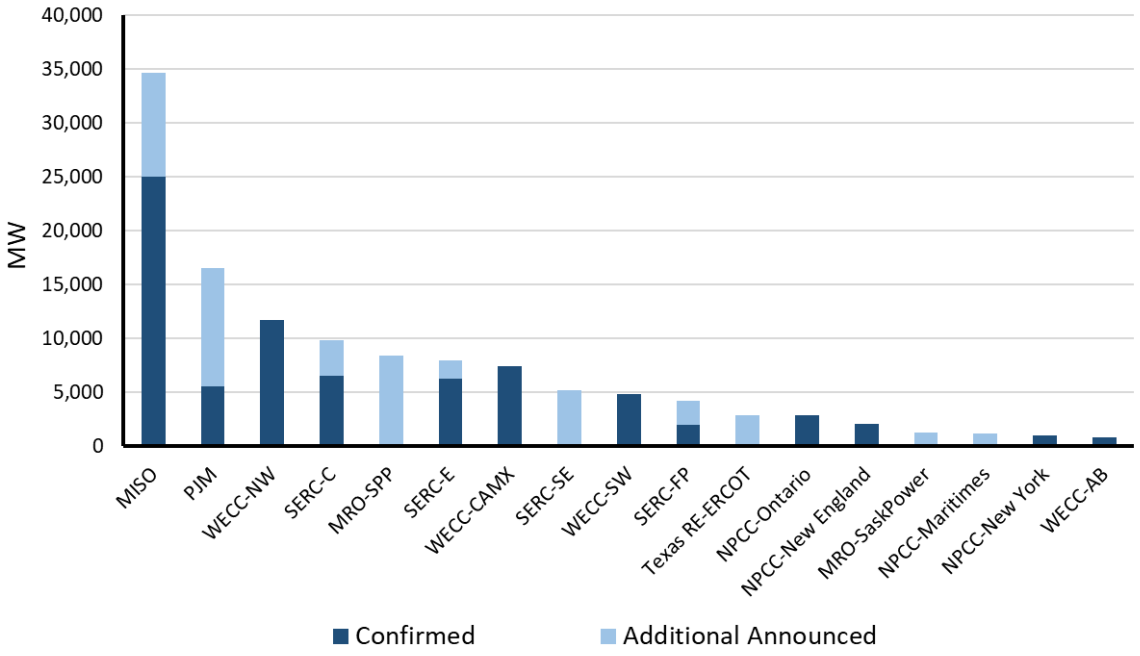
- Load-loss events: more *likely* in summer…more **severe** in winter



Unserved Energy Events in Probabilistic Assessment Study Year 2026

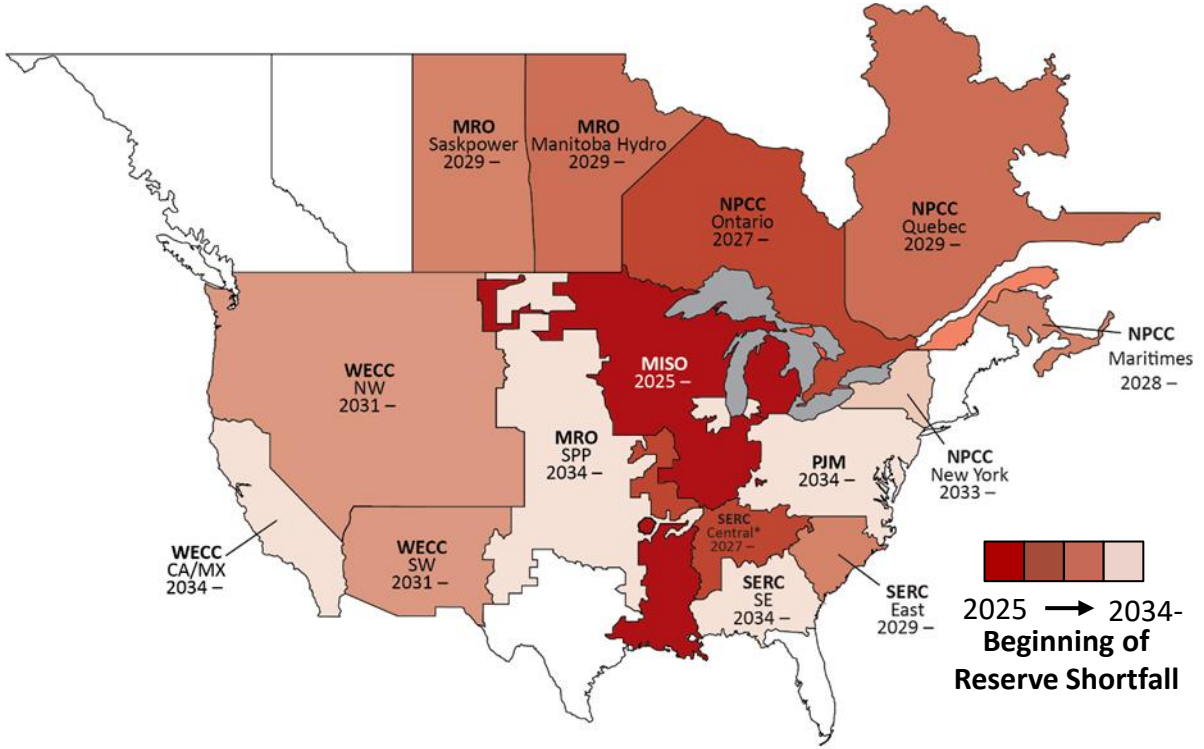
More Resources Are Needed To Meet Expected Retirements

- Areas are projected to fall short of reserve margin requirements as generation retirements continue at rapid pace
- Generator retirements through 2034 (thermal): 78 GW confirmed + 37 GW announced



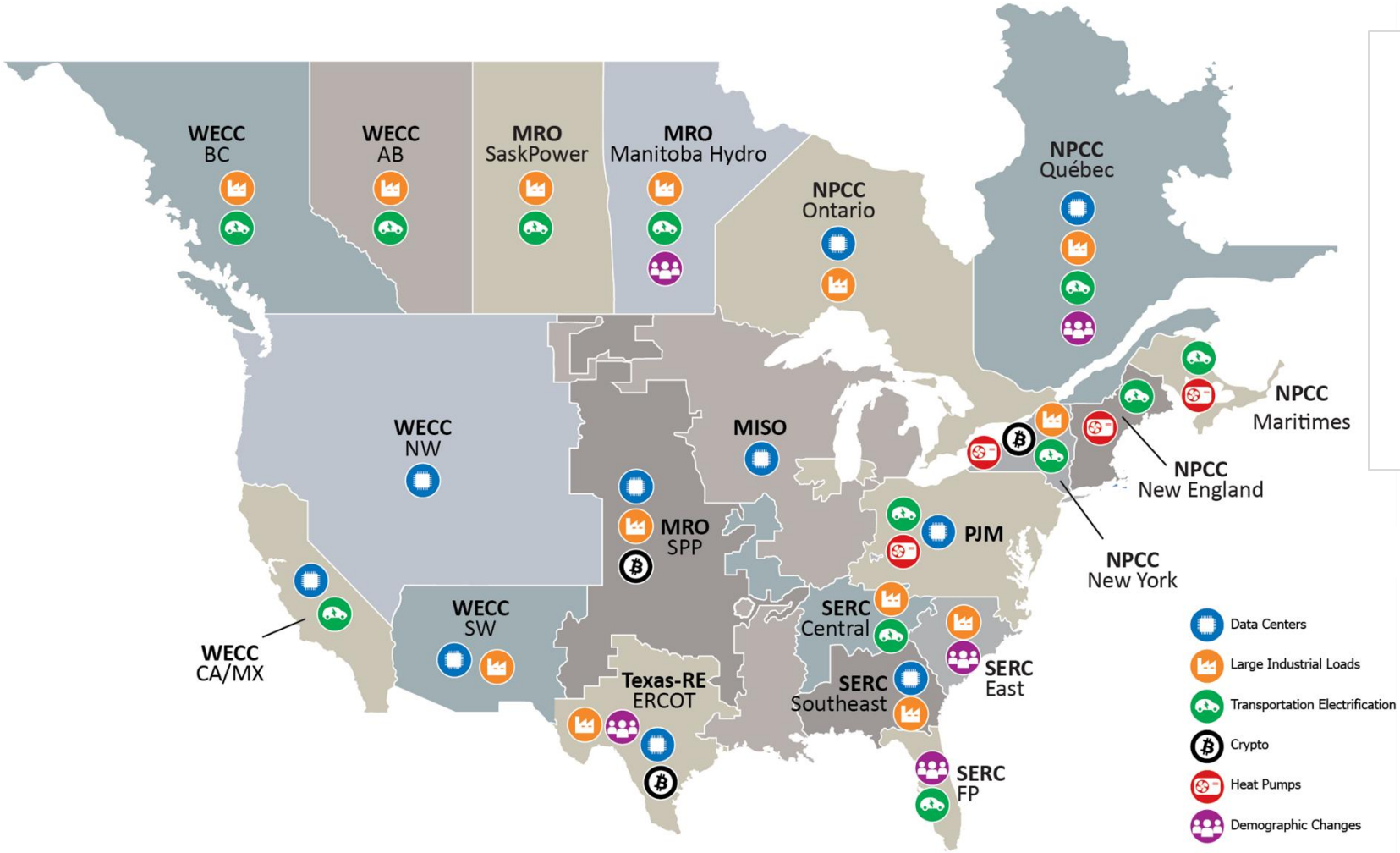
Fossil-fired and Nuclear Generator Retirements by 2034

Source: Energy Ventures Analysis, Inc and LTRA Data

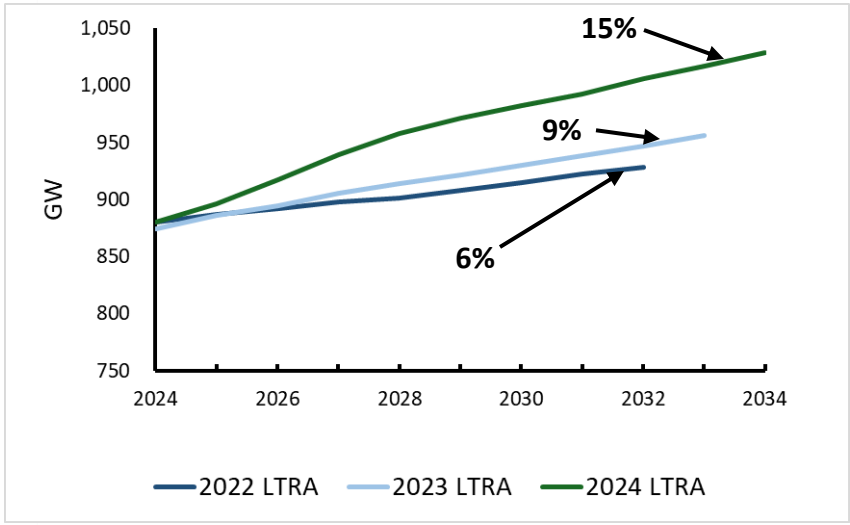


Reserve Margin Shortfall Projections Over the 10-Year Period

Demand Growth Is Accelerating



Demand Growth Drivers



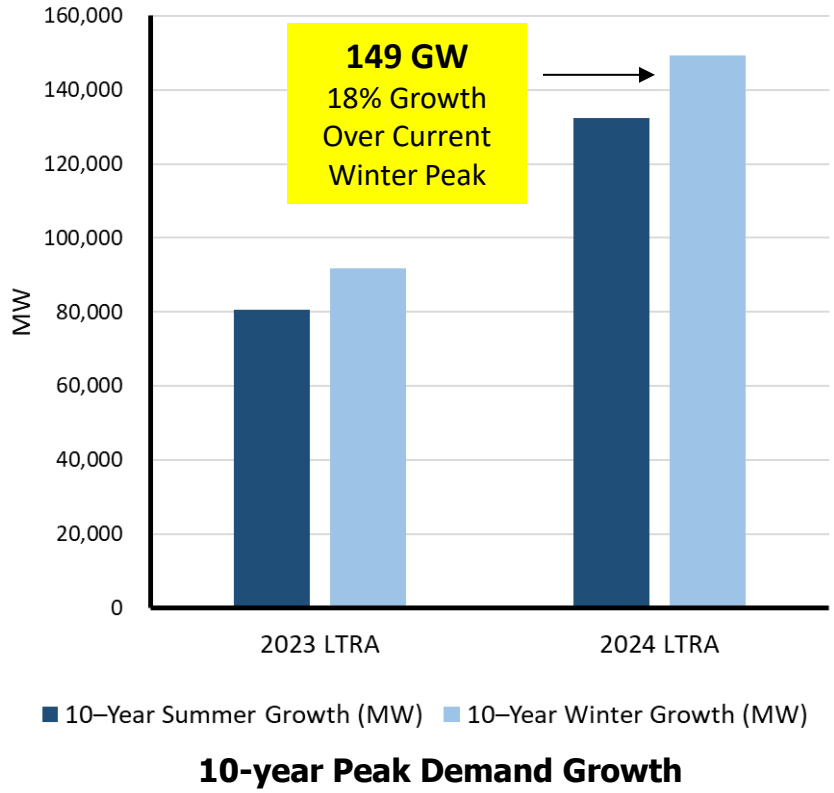
10-year BPS Summer Peak Demand Growth

With 10-year Growth From Previous LTRA

Demand Growth | Winter Is Outpacing Summer

- Winter peak demand continues to rise faster than summer peak demand
- This trend is driven by electrification and increasing amounts of solar PV distributed energy resources
- In 10 of 14 summer-peaking assessment areas: winter demand growth rates > summer growth

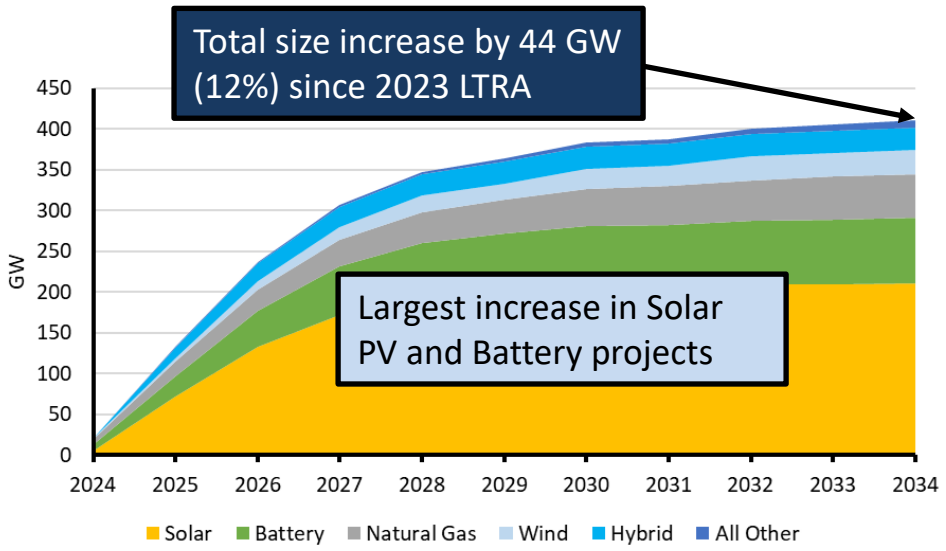
- **Resource planning must increasingly focus on winter fuel and energy risks, generator performance, and load forecasting**



10-year Peak Demand Growth

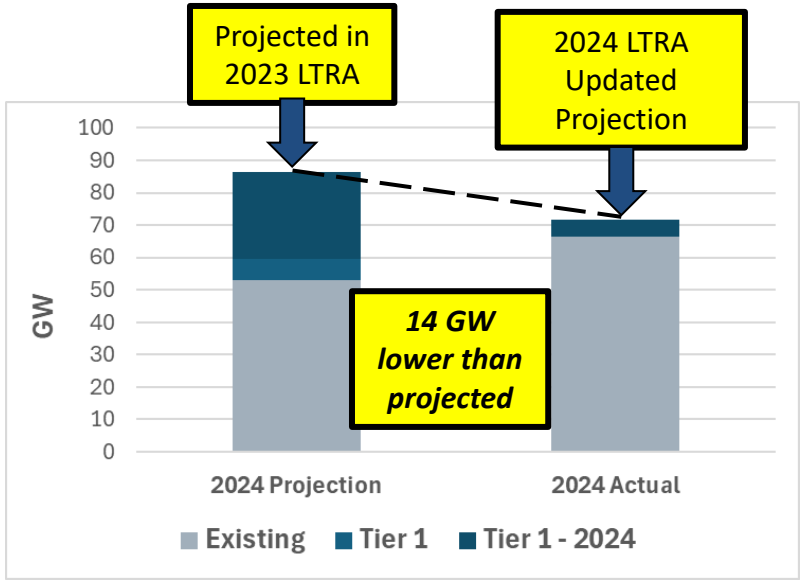
Resources Projections Reflect Slower Rate of Additions

- Resources in the interconnection process continue to grow



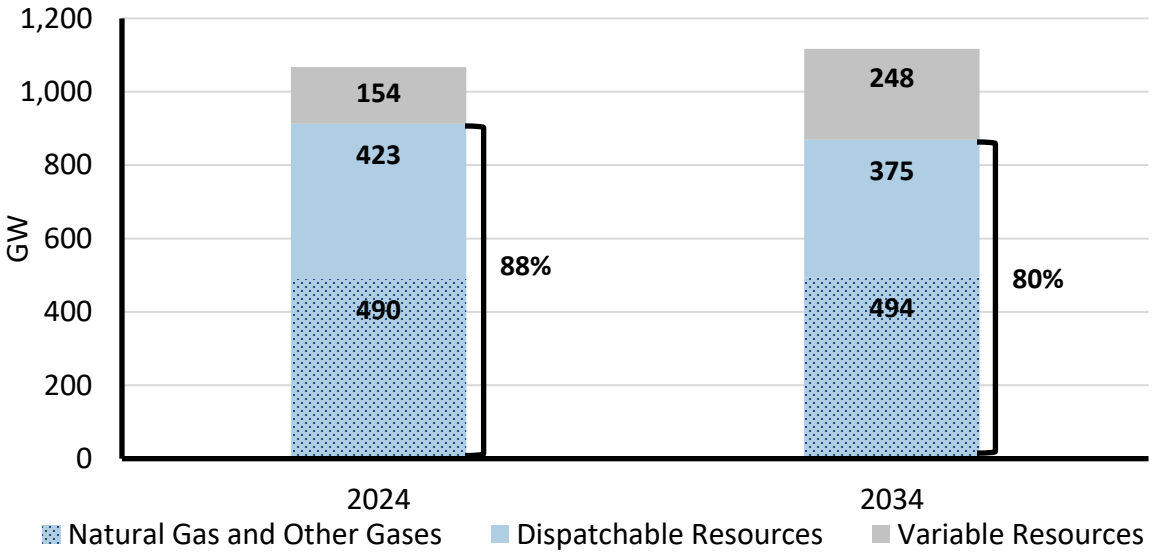
Resources in Interconnection Process
Tier 1 (Signed Agreements) and Tier 2 (Processing)

- Project delays and cancellations are causing resource growth to fall short of projections



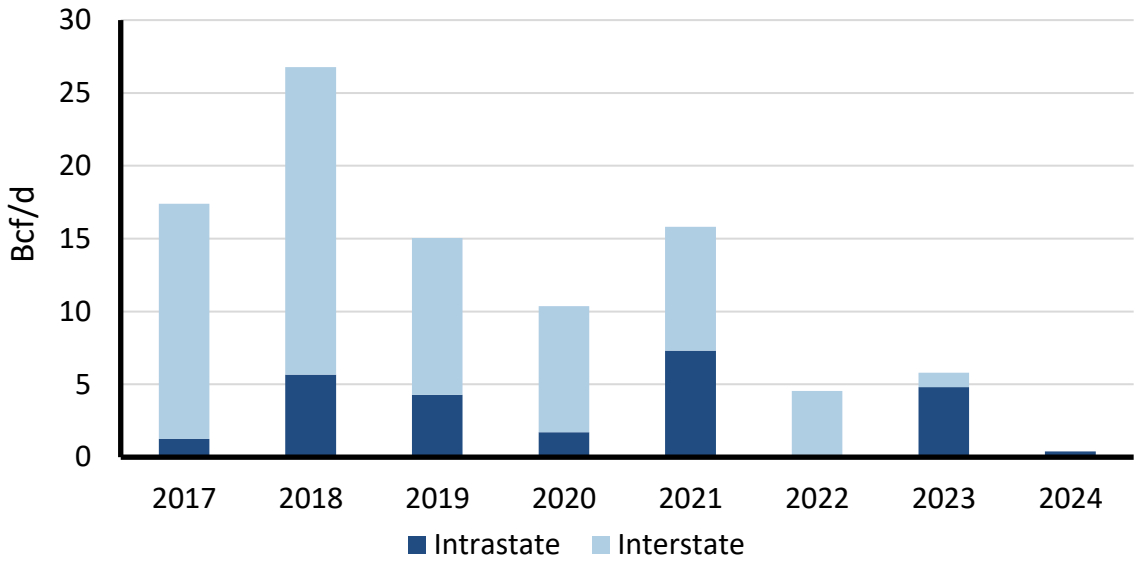
Solar On-Peak Capacity | prior-year projection v. current year actual

Criticality of Natural Gas Intensifies



2024-2034 Change in Natural Gas and Dispatchable Capacity

- Natural gas' share of the dispatchable resource capacity mix rises from 52% to 55% over the next 10 years as dispatchable resources overall decline, largely due to coal retirements.



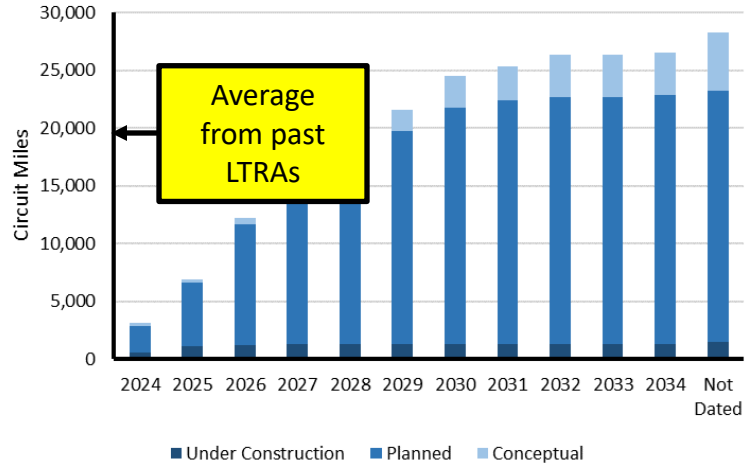
U.S. Pipeline Expansion Projects

Source: U.S. Energy Information Administration

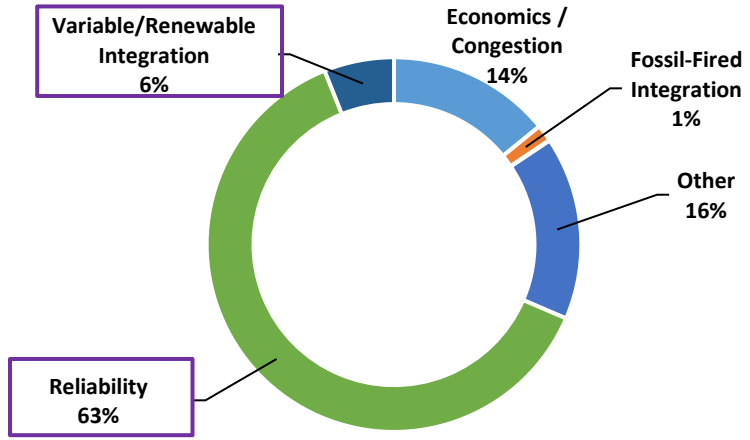
- Nearly 14 Bcf/d worth of gas pipeline projects planned in the U.S., not designated to serve LNG export demand, have been approved or are under construction. Of those projects, roughly 9 Bcf/d are located within Texas and nearly 3 Bcf/d is planned to expand exports to Mexico.

Transmission Development Is Increasing

- **Increase in transmission development:** Miles of transmission in-development have risen vs. past LTRA average
- Miles of new transmission projects *under construction* have not increased
- Siting and permitting issues continue to delay projects (affects over 1,200 miles of transmission)
- Assessment areas report significant investment in transmission development including projects to increase transfer capability



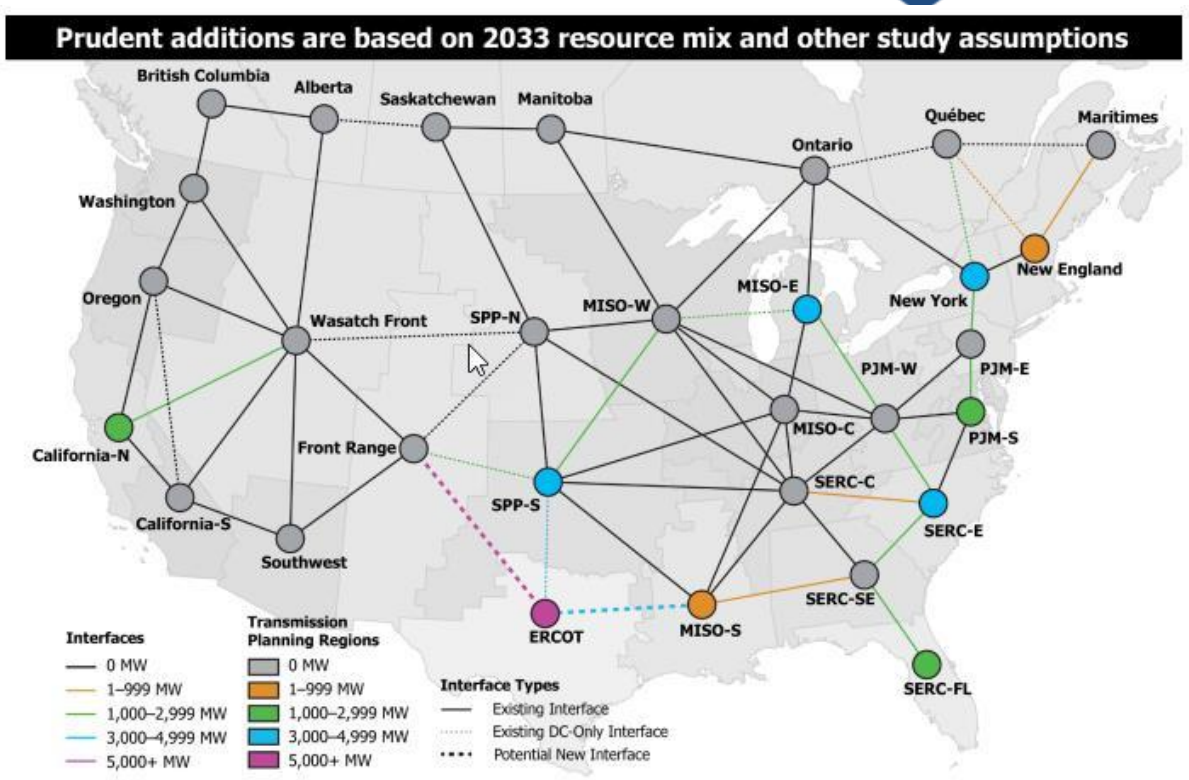
2024 LTRA Cumulative Transmission Projects >100 kV



2024 LTRA Transmission Project Primary Driver

Increasing Transfer Capability Can Reduce Energy Shortfalls

- NERC Interregional Transfer Capability Study (ITCS) finding: **additional 35 GW transfer capability in the U.S. would improve energy adequacy in extreme weather**
- Transmission alone will not resolve all identified shortfalls → supply resources are needed
- ITCS recommendations to planners include considering all options to address system needs:
  - Transmission and transfer capability
  - Local generation and storage
  - Demand side management



ITCS Prudent Additions to Transfer Capability

NERC performed the ITCS to meet the requirements of the Fiscal Responsibility Act of 2023. Study information and results can be found on NERC's ITCS Webpage

Emerging Issues

Data Centers and Large Industrial Load	Growth in large load parcels like data centers and industrial facilities pose various challenges for system planners and operators.
Battery Energy Storage Systems (BESSs)	Poor visibility of BESSs' state-of-charge poses risks for operators who expect energy available for dispatch.
Electric Vehicles and Electric Load	With increased adoption of Electric Vehicles (EVs) there is a need to understand the impact of battery charging on system performance.
Energy Drought	More reliance on wind, solar, and hydro resources in the resource mix has the potential to expose the electricity system to supply shortages under abnormal weather patterns.

Recommendations

Resource planners, market operators, and regulators| **carefully manage generator deactivations**

NERC and Regional Entities| **improve the LTRA with energy metrics, consistent methods, and wide-area energy analysis**

Regulators and Policymakers| **streamline siting and permitting to remove barriers to resource and transmission development**

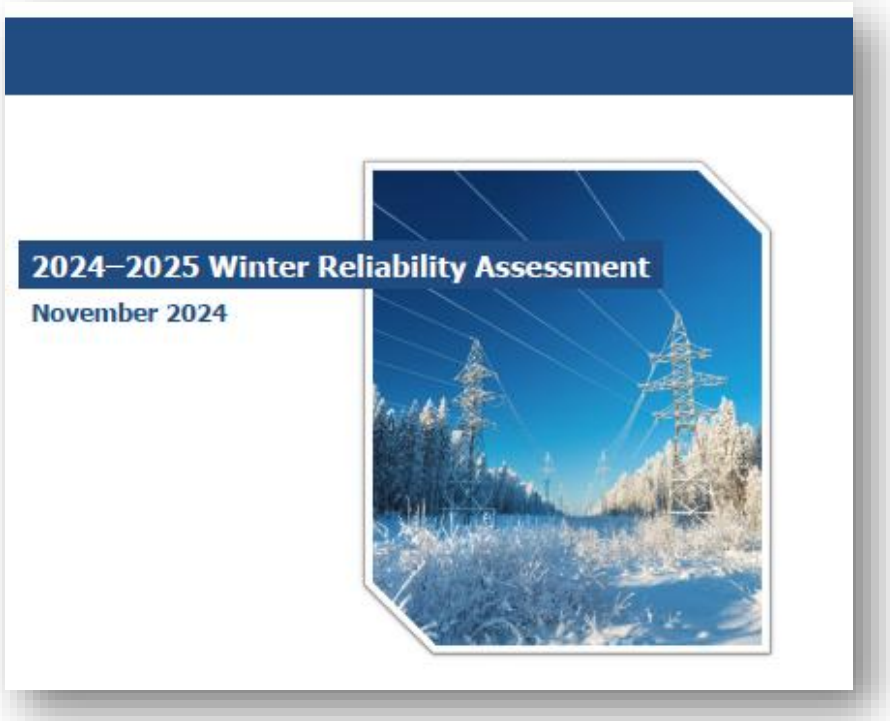
Regulators, industry, and gas industry| **implement a framework for addressing reliability needs of the interconnected energy system**

ISOs/RTOs, regulators| **continue steps to ensure sufficient Essential Reliability Services**

Annual Winter Assessment Highlights

Key Takeaways

- Extreme winter conditions pose familiar challenges for bulk power system reliability
  - High electricity demand and forecasting challenges
  - Generator performance
  - Fuel supply issues
- Resources are adequate across North America for normal peak conditions
- Regulatory and industry initiatives are reducing winter reliability risks

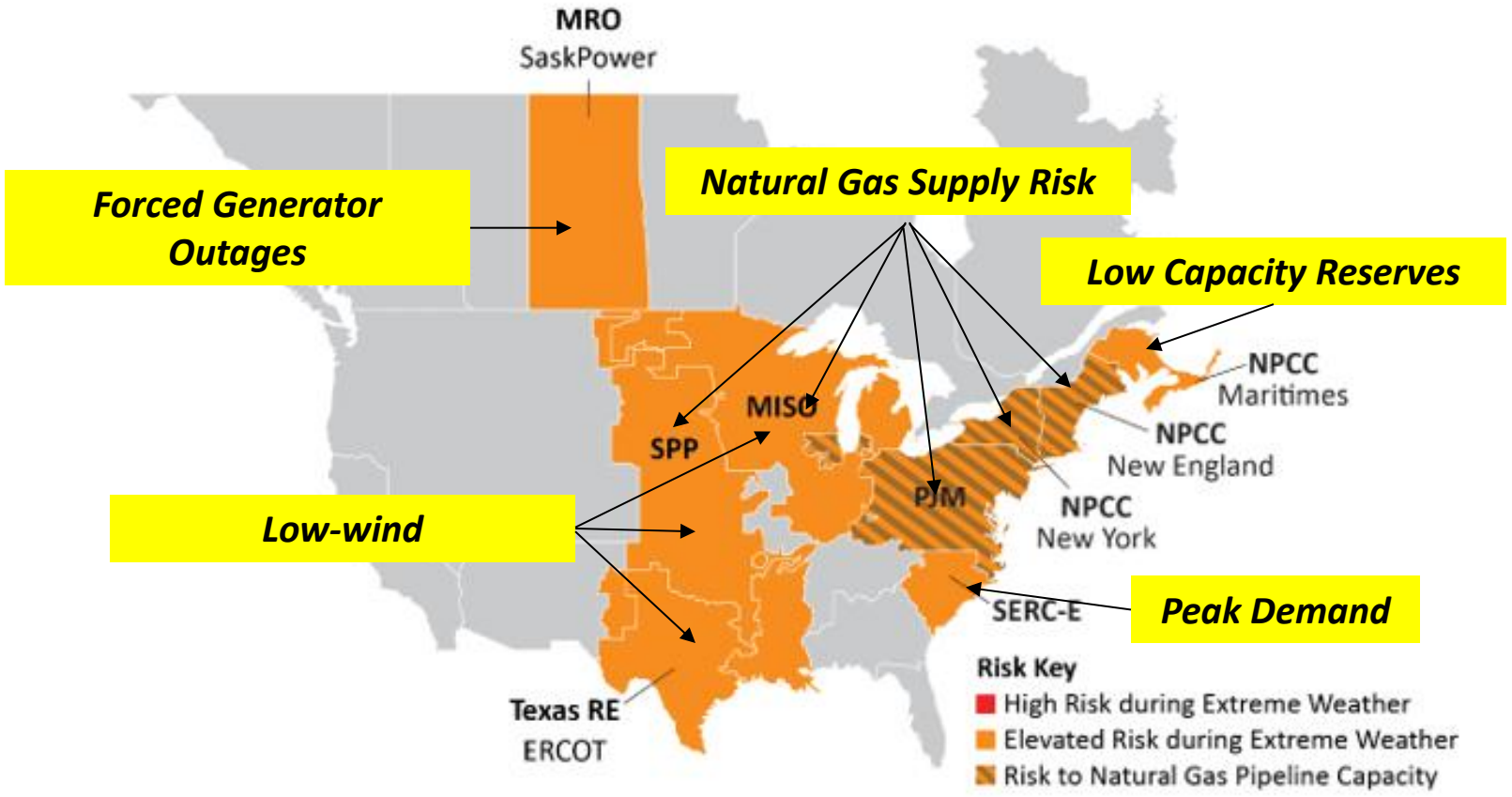


The WRA examines resource adequacy, risk scenarios, and industry preparations for the winter season.

2024-2025 Winter Risk Area Summary

Key Risk Elements During Extreme Winter Conditions

Results of WRA Probabilistic Analysis and Operational Risk Scenarios



2024-2025 Winter Reliability Risk Map

Questions and Answers