



MIDWEST
RELIABILITY
ORGANIZATION

Midwest Reliability Organization: Kansas Corporation Commission Education Session

Tasha Ward, J.D., CCEP

Director of Enforcement and External Affairs

Bryan Clark, P.E.

Director of Reliability Analysis

Mark Tiemeier, P.E.

Principal Technical Advisor

February 8, 2023

Introductions



Mark Tiemeier, PE, Principal Technical Advisor

Mark Tiemeier joined the Midwest Reliability Organization in July 2022 as Principal Technical Advisor. Prior to joining MRO, Mark worked for 15 years at Xcel Energy and 2 years at Midcontinent Independent System Operator, in engineering and supervisory roles within transmission system operations. Mark is a registered Professional Engineer in the state of Minnesota.



Bryan Clark, PE, Director of Reliability Analysis

Bryan Clark joined the Midwest Reliability Organization in June 2018 as a Sr. Operations Engineer and was promoted to Director of Reliability Analysis in January 2019. Bryan has over 17 years of experience working with electric utilities, including time at Entergy and Southwest Power Pool, Inc.



Tasha Ward, Director of Enforcement and External Affairs

Tasha Ward joined the Midwest Reliability Organization in October 2019 and holds the position of Director of Enforcement and External Affairs. Tasha has over 13 years of industry experience working within the Electric Reliability Organization, including time at the Southwest Power Pool Regional Entity, SERC Reliability Corporation, and Southwest Power Pool, Inc.



Agenda

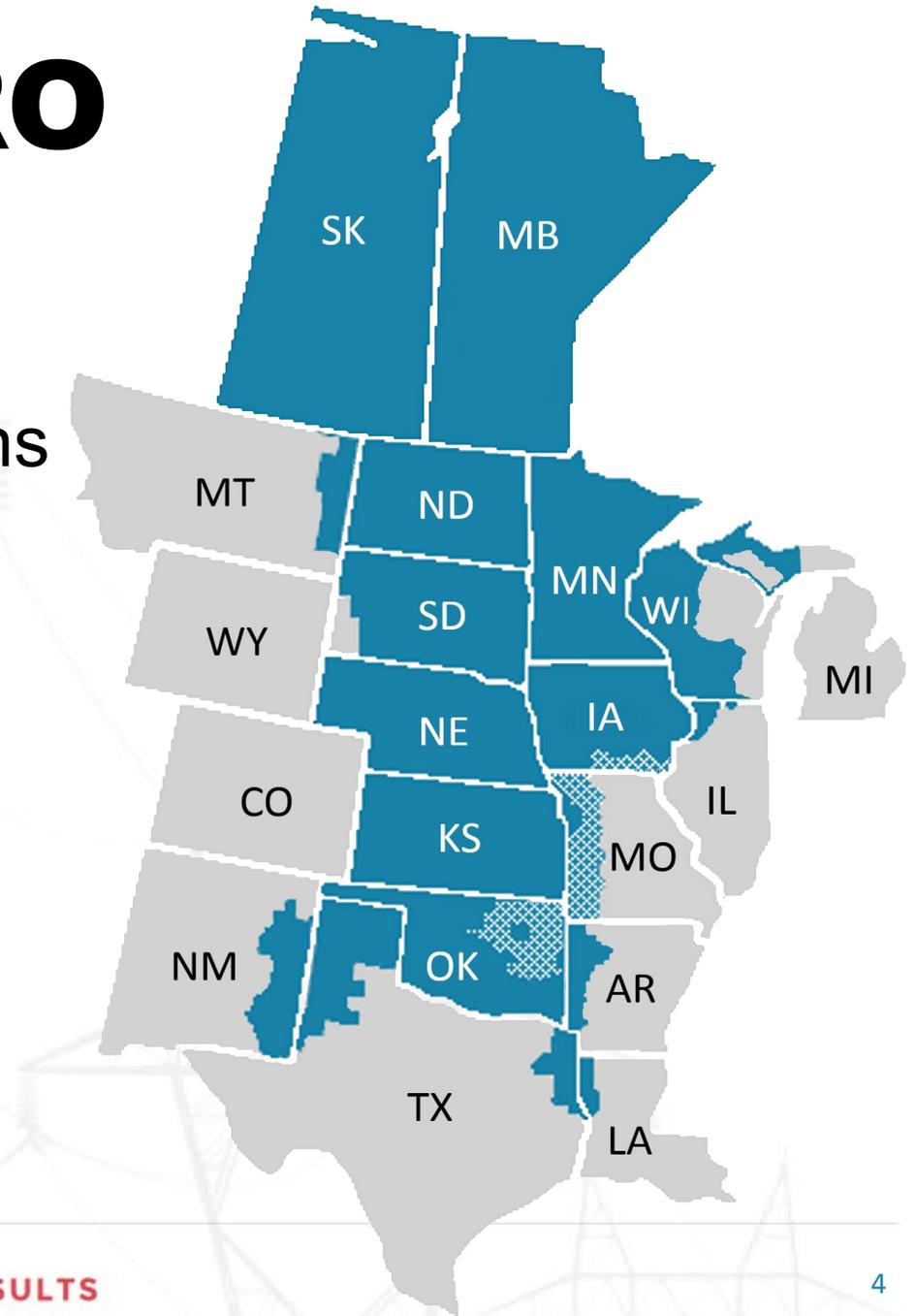
- **About MRO**
- **Reliability Analysis**
- **Regional Risk Assessment**



About MRO

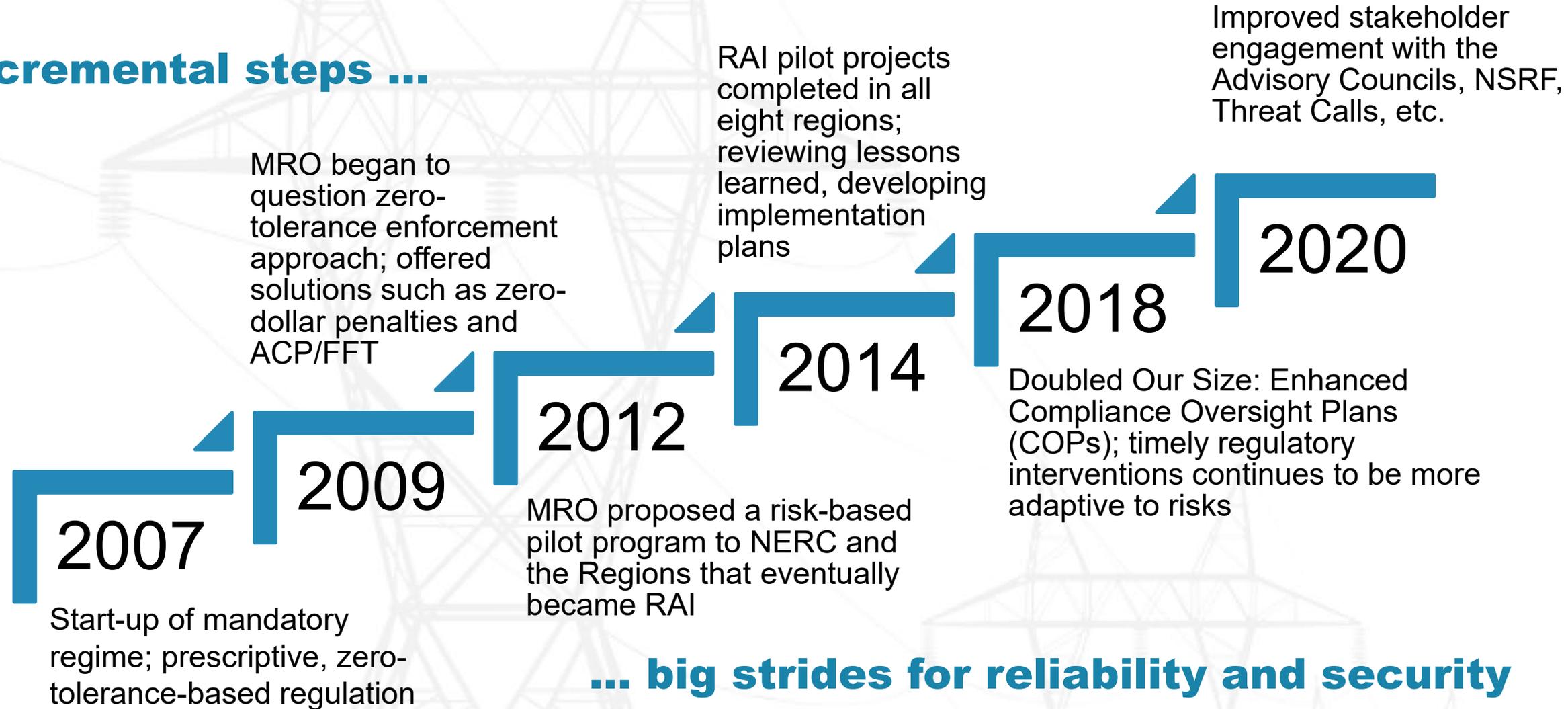
- **Company profile:**

- Incorporated in 2002; began operations in 2007
- Headquartered in St. Paul, MN
- Regional footprint includes more than 220 registered entities



Our History

Incremental steps ...



Our Vision:

***A highly reliable and
secure North American
bulk power system.***





The hallmark of reliability in complex, interdependent systems is not that errors won't occur...

It's that errors and operating anomalies won't create an uncontrolled, cascading event.

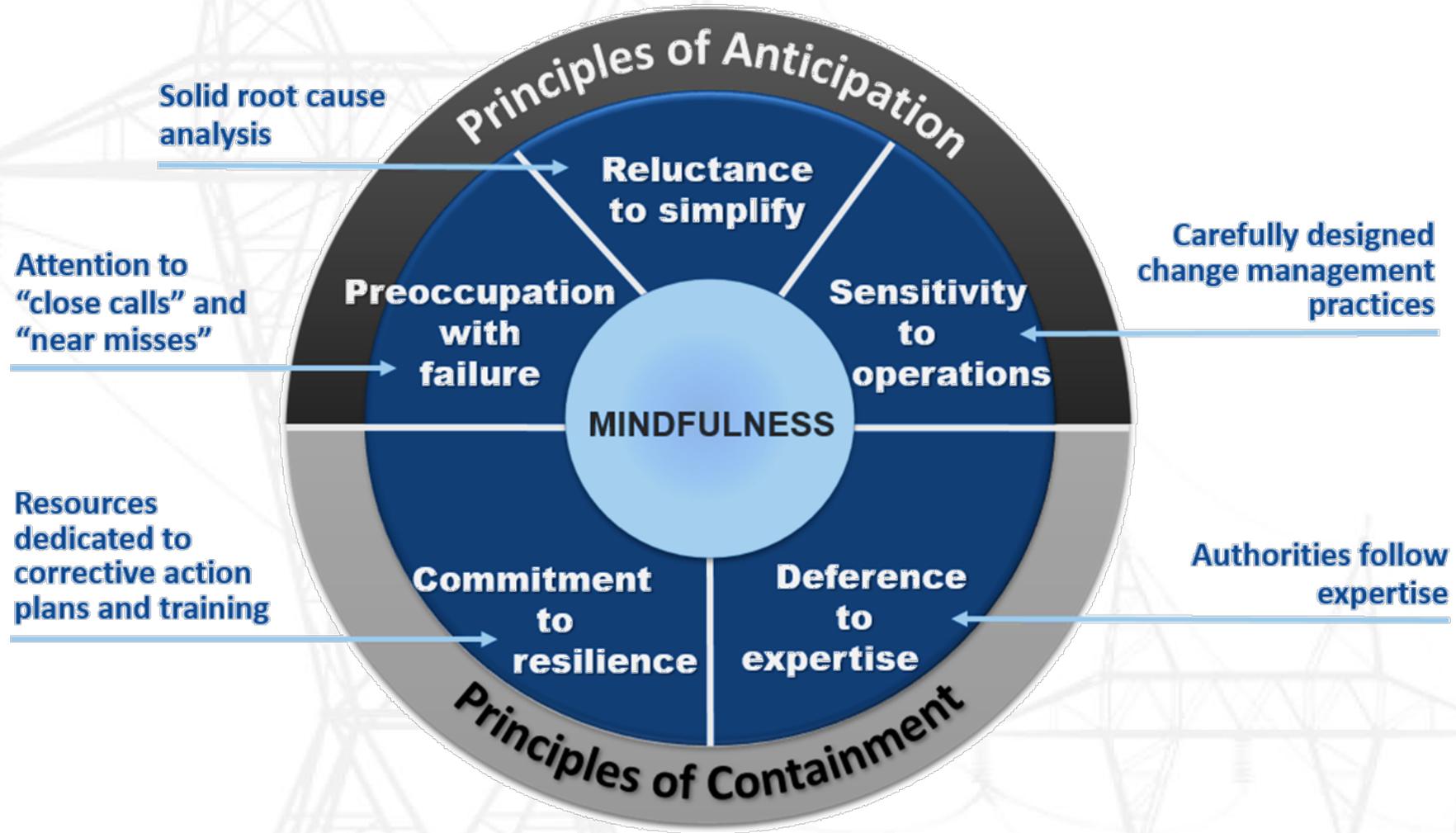
What It Means To Be Reliable

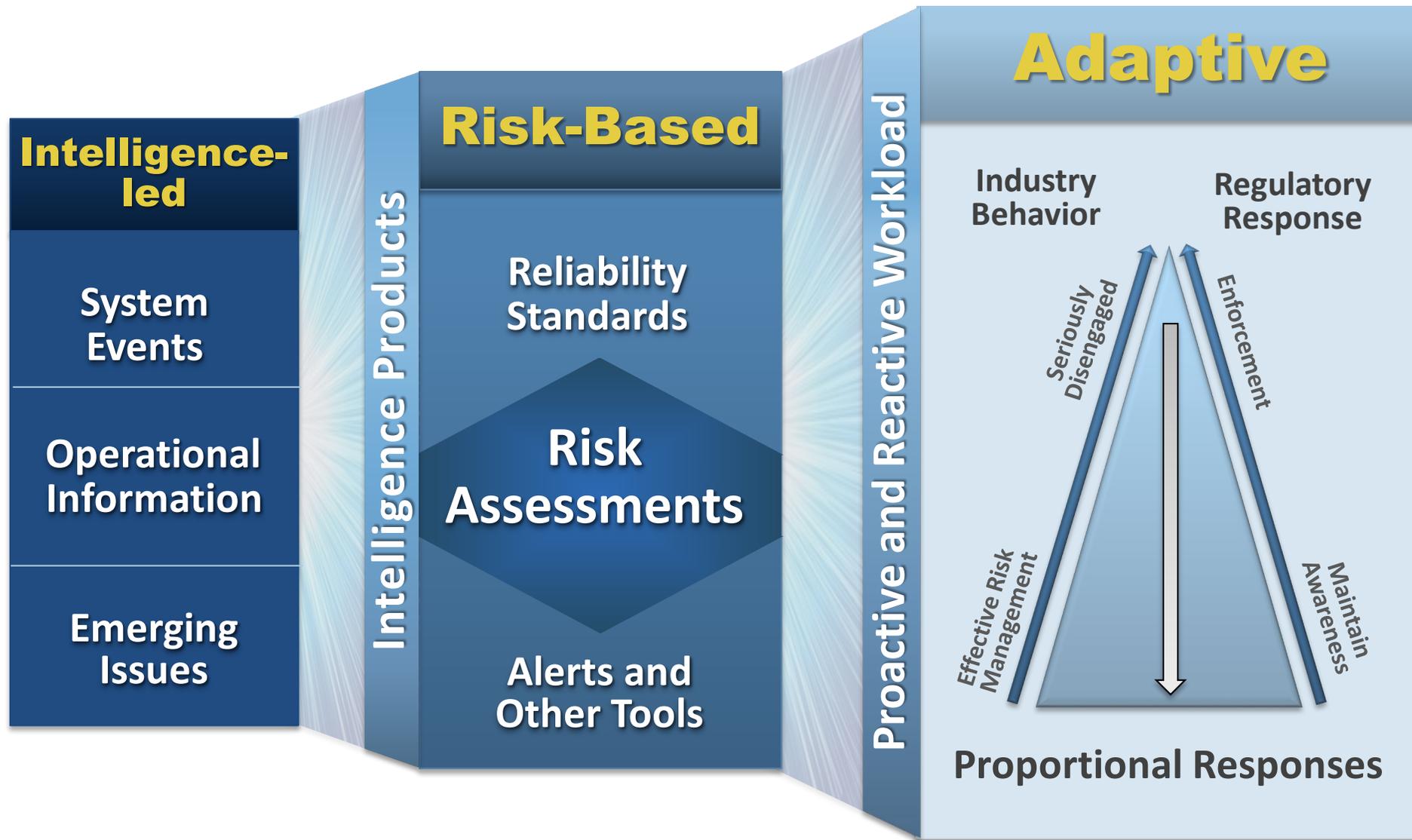
MRO's Mission Supports the Vision

*To identify, prioritize and assure effective and efficient mitigation of risks to the reliability and security of the North American bulk power system by promoting **Highly Effective Reliability Organizations (HEROs)**.*



Key Characteristics of HEROs





Supporting the Work of HEROs

A Risk-Based Regulatory Approach

MRO's Organizational Groups

- **MRO leverages its members' experience and expertise on several organizational groups**
- **MRO's organizational group structure consists of three advisory councils:**
 - CMEP Advisory Council
 - Reliability Advisory Council
 - Security Advisory Council
- **Several subgroups reside under the councils**



Important Work of the Councils

- **CMEP Advisory Council activities:**
 - Work to integrate HRO theory and principles in support of MRO's Mission
 - Provide a forum for registered entities to discuss and comment on new or revised NERC Reliability Standards
 - Develop industry guidance on the application of existing and proposed NERC Reliability Standards
 - Provide guidance to regional stakeholders on sound governance risk and internal control programs
 - Foster industry peer assistance and networking



Important Work of the Councils

- **Reliability Advisory Council activities:**

- Work closely with regional Planning Coordinators to understand regional risks, like the changing resource mix
 - Track regional risks; provide mitigating strategies, lessons learned and other guidance to regional stakeholders
- Review and provide input on North American-wide and regional reliability assessments
- Review regional system events and misoperations to identify trends and mitigation approaches; provide technical input to staff
- Assess the various human performance aspects of system operator functions, field technicians, design engineers, and others
- Support MRO's stakeholder outreach efforts by sponsoring and leading the implementation of MRO conferences and events



Important Work of the Councils

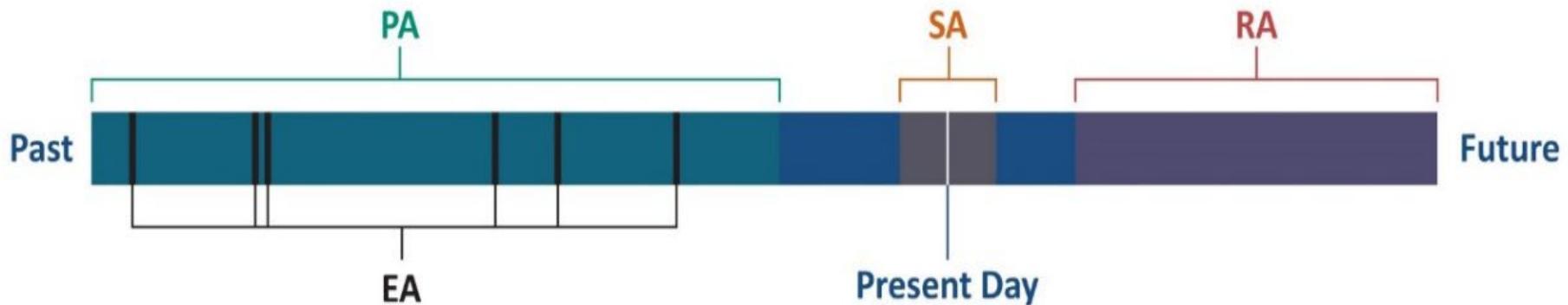
- **Security Advisory Council activities:**
 - Promote security of the regional bulk power system, focusing on cybersecurity, physical security and SCADA, EMS, and substation and/or generation control systems
 - Identify and track regional security risks and distill information on security-best practices and lessons learned
 - Maintain collaborative relationships with E-ISAC, DHS, FBI, and other federal and provincial intelligence agencies
 - Increase information-sharing through weekly threat calls and regional security contact lists
 - Provide technical expertise to staff and input on MRO's Regional Risk Assessment
 - Identify areas for guidance and training and provide outreach to MRO stakeholders on important security-related topics



About MRO's Reliability Analysis Department

- **What we do:**
 - Reliability Assessments
 - Bulk Power Situational Awareness
 - Event Analysis
 - Performance Analysis
 - Entity Registration and Certification





Reliability Assessments

- **Review, assess, and report on the overall electric generation and transmission reliability of the interconnected Bulk Power System.**
- **NERC Reliability Assessment Subcommittee (RAS)**
- **3 Annual reports**
 - Winter Reliability Assessment
 - Summer Reliability Assessment
 - Long Term Reliability Assessment



Reliability Assessments

- **2 Internal Assessments with an emphasis on the MRO region**
 - Regional Winter Assessment
 - Regional Summer Assessment



2022 Long-Term Reliability Assessment

The LTRA identifies reliability trends, emerging issues, and potential risks to the bulk power system over a 10-year horizon.

High Risk

Anticipated reserves fall below Reference Margin Levels, and energy risks exist in normal peak demand conditions during one or more years:

California-Mexico

The addition of new resources and retention of key generators is alleviating near-term capacity shortages, but energy risks persist. Variable resource output and changing demand could cause energy shortfalls that range from 1–10 hours.

MISO

A projected shortfall of 1,300 MW occurs next summer and continues to grow throughout the 10-year assessment period as coal, nuclear, and natural gas generation retire faster than replacement resources are connecting.

Ontario

A reserve margin shortfall of 1,700 MW begins in 2025 and continues to grow throughout the 10-year assessment period due to generation retirements and lengthy planned nuclear maintenance outages.

Elevated Risk

Reserves meet resource adequacy criteria, but the risk of energy shortfalls exists in severe hot or cold weather (90/10 extreme event):

U.S. Northwest and Southwest

The risk of energy shortfalls from wide-area, long-duration heat events are expected to increase. Coal and natural gas generation retirements and lower amounts of hydro availability threaten reliability over the next 10 years. With high reliance on energy transfers, wide-area severe weather poses an increased risk to electricity supplies and transmission network impacts.

Texas

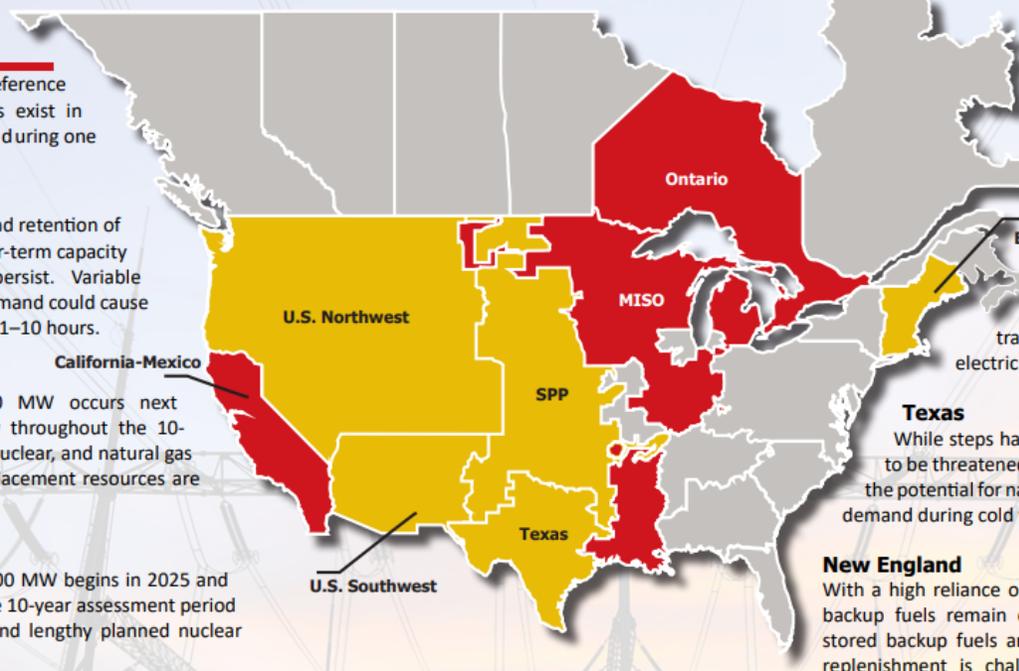
While steps have been taken since Winter Storm Uri, reliability continues to be threatened in severe winter weather conditions by generator outages, the potential for natural gas supply disruptions, and abnormally high electricity demand during cold weather.

New England

With a high reliance on natural gas generation, liquefied natural gas and stored backup fuels remain critical to reliability over the next 10 years. Units with stored backup fuels are threatened by market conditions. Fuel availability and replenishment is challenged in severe winter weather. Over the long-term, infrastructure contingencies become reliability risks during any time of the year.

SPP

Energy shortfalls are likely during low-wind, high demand periods.



Key Trends

Retirements

More than 88 GW of generating capacity is confirmed for retirement over the assessment period (similar to the 10-year projection in the 2021 LTRA) with an additional 22 GW of generators that could retire within the next five years. It is critical that the pace of generator retirements be managed until solutions are in place that can continue to meet energy needs and provide essential reliability services.

Demand Growth

For the first time in recent years, electricity peak demand projections are increasing. Adoption of electric vehicles and other energy transition programs will significantly influence demand.

Flat Transmission Growth

Transmission development projections remain near the five-year averages and less than 15% of projects are driven by new resource integration. Large-scale regional projects are needed to interconnect the volume of wind and solar generation in development and meet regional demand.

Integration of Inverter-Based Resources

More than 70% of new generation in development is solar, wind, and hybrid-battery, making reliable integration of new resources paramount.

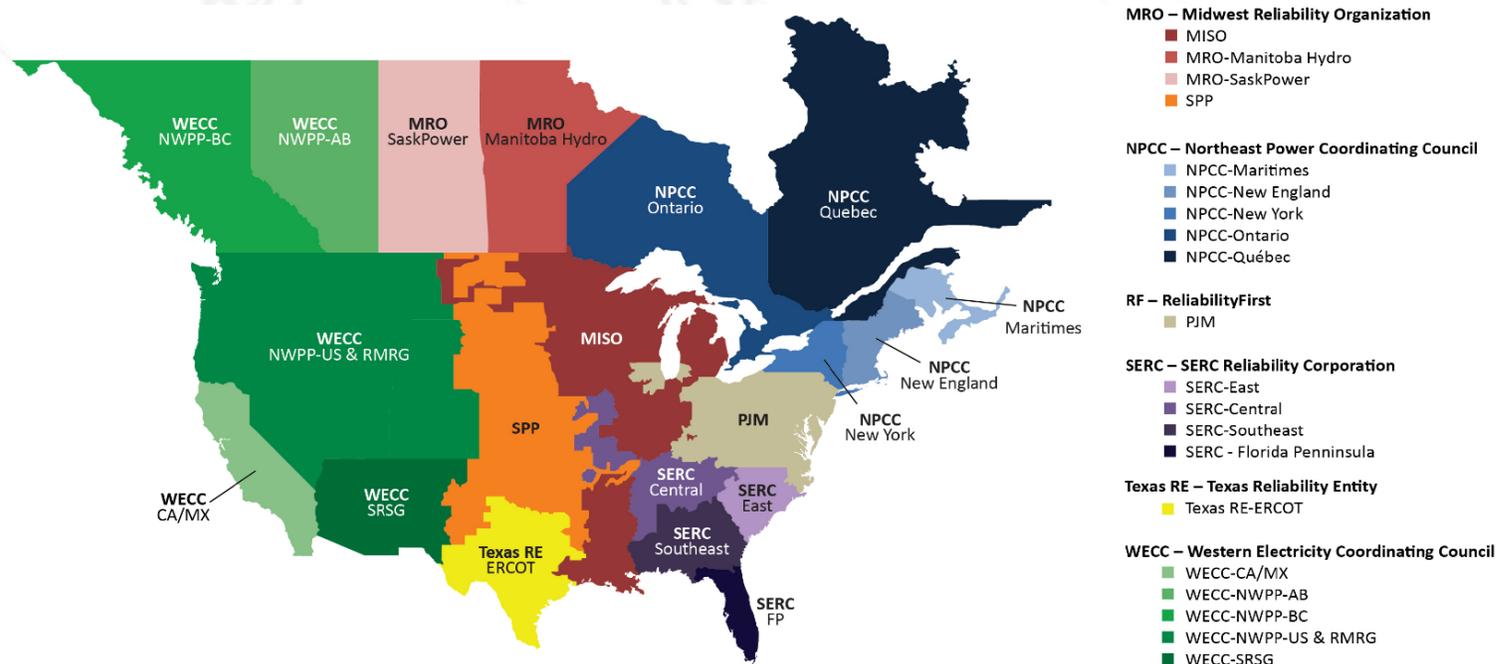
Growth in Distributed Energy Resources

Solar photovoltaic distributed energy resources are projected to reach more than 80 GW by the end of this 10-year assessment, a 25% increase in projection since the 2021 LTRA.



Long-Term Reliability Assessment

- 10-year assessment of resource capacity and energy risks
- Uses industry's demand and generation forecasts and transmission projections



SPP Assessment Area

- **Reserve Margins are above the Reference Margin Level through the 10 year assessment period**
- **Slight increase in Internal Demand over the assessment period**
- **Steady increase in wind generation across the SPP assessment area**



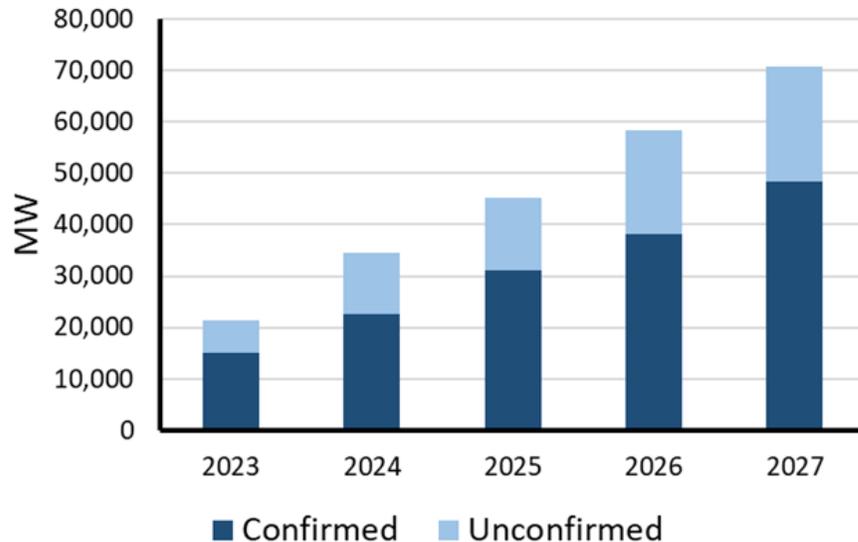
Resource Mix

- **Over 88 GW of fossil-fired and nuclear generating capacity is confirmed for retirement during the assessment period**
- **Additional 22 GW could retire within the next five years and exacerbate capacity and energy shortfalls**
- **Robust planning processes for managing the pace of generator retirements are needed to prevent energy risks and system reliability issues**



Resource Mix

- Capacity of Retiring Generation through 2027
- Wind, solar, and hybrid lead the transition



Type	Capacity (GW)	Change since 2021 (GW)
Natural Gas	477	+14
Coal	202	-18
Nuclear	106	-2
Solar and Wind	70	+19
All others	189	+2

Contributions at hour of peak demand. VER (solar, wind, and some hydro) typically count less than installed nameplate capacity.

LTRA Recommendations

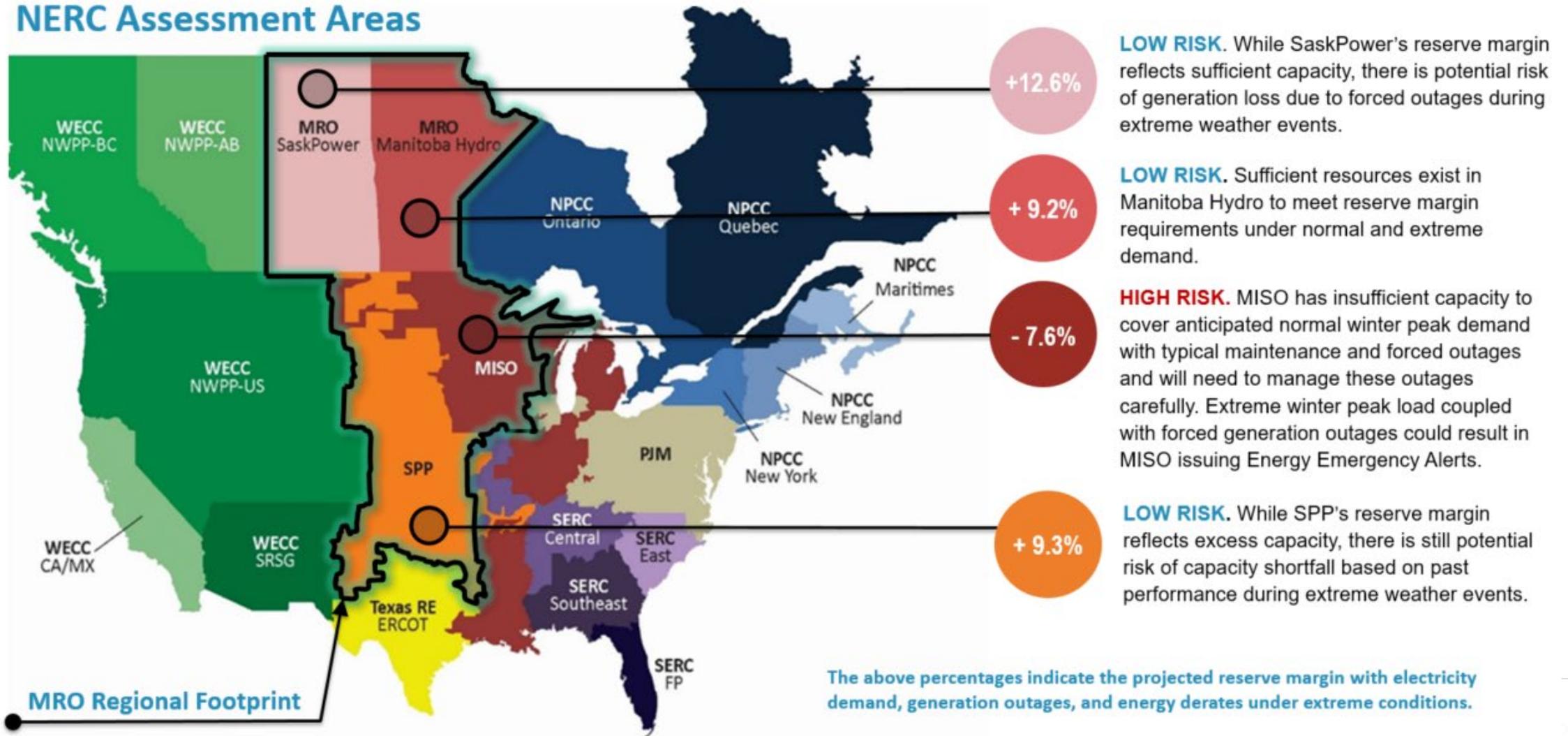
- **Manage the pace of generator retirements to ensure energy and essential reliability services needs are met**
- **Promote use of extreme weather scenarios in resource planning**
- **Expand resource adequacy evaluations beyond reserve margins to include energy risks for all hours and seasons**
- **Mitigate risks from interdependent natural gas infrastructure**
- **Address performance and integration issues with solar and wind**
- **Increase focus on operating with more distribution resources**
- **Consider the impact of electrification on future electricity demand and infrastructure**



2022 Regional Winter Assessment

Elevated areas of risk that will require increased monitoring during the upcoming winter season

NERC Assessment Areas



Normal Peak Demand with Typical Outages

Assessment Area	Anticipated Resources	Typical Maintenance and Forced Outages	Anticipated Resources with Typical Outages	Net Internal Demand	Anticipated Reserve Margin with Typical Outages	Reserve Margin Requirements
MH	5,418	85	5,333	4,588	16.2%	12.0%
MISO	141,565	28,818	112,747	98,939	14.0%	17.9%
SPC	4,779	249	4,530	3,714	22.0%	15.0%
SPP	70,772	10,600	60,172	41,637	44.5%	16.0%

Anticipated Reserve Margin for Normal Forecast with Typical Outages

- MISO has insufficient resources under normal winter peak demand with typical outages



Extreme Winter Resource and Peak Demand Scenario

Assessment Area	Anticipated Resources with Typical Outages	Extreme Derates	Extreme Low Generation	Operational Mitigations	Extreme Low Generation + Operational Mitigations	Extreme Peak Load
MH	5,333	0	5,333	0	5,333	4,882
MISO	112,747	17,624	95,123	2,400	97,523	105,513
SPC	4,530	123	4,407	0	4,407	3,914
SPP	60,172	11,940	48,232	0	48,232	44,137

Extreme Winter Resource and Peak Demand Scenario (in MWs)

- MISO resources fall significantly below the extreme peak load likely need to issue EEAs



Normal vs. Typical Outages vs. Extreme Scenario

The Difference



Assessment Area	Reserve Margin Requirements	Anticipated Reserve Margin	Typical Outages	Extreme Conditions
MH	12.0%	18.1%	16.2%	9.2%
MISO	17.9%	43.1%	14.0%	-7.6%
SPC	15.0%	28.7%	22.0%	12.6%
SPP	16.0%	70.0%	44.5%	9.3%



Regulator Recommendations

- Preserve critical generation resources at risk of retirement ahead of the winter season to maintain reliability.
- Understand requests for environmental and transportation waivers that place fuel at risk.
- Support electric load and natural gas distribution company conservations and public appeals during emergencies.
- Seek local policies that continually balance new and different generation resources with increased power demand.

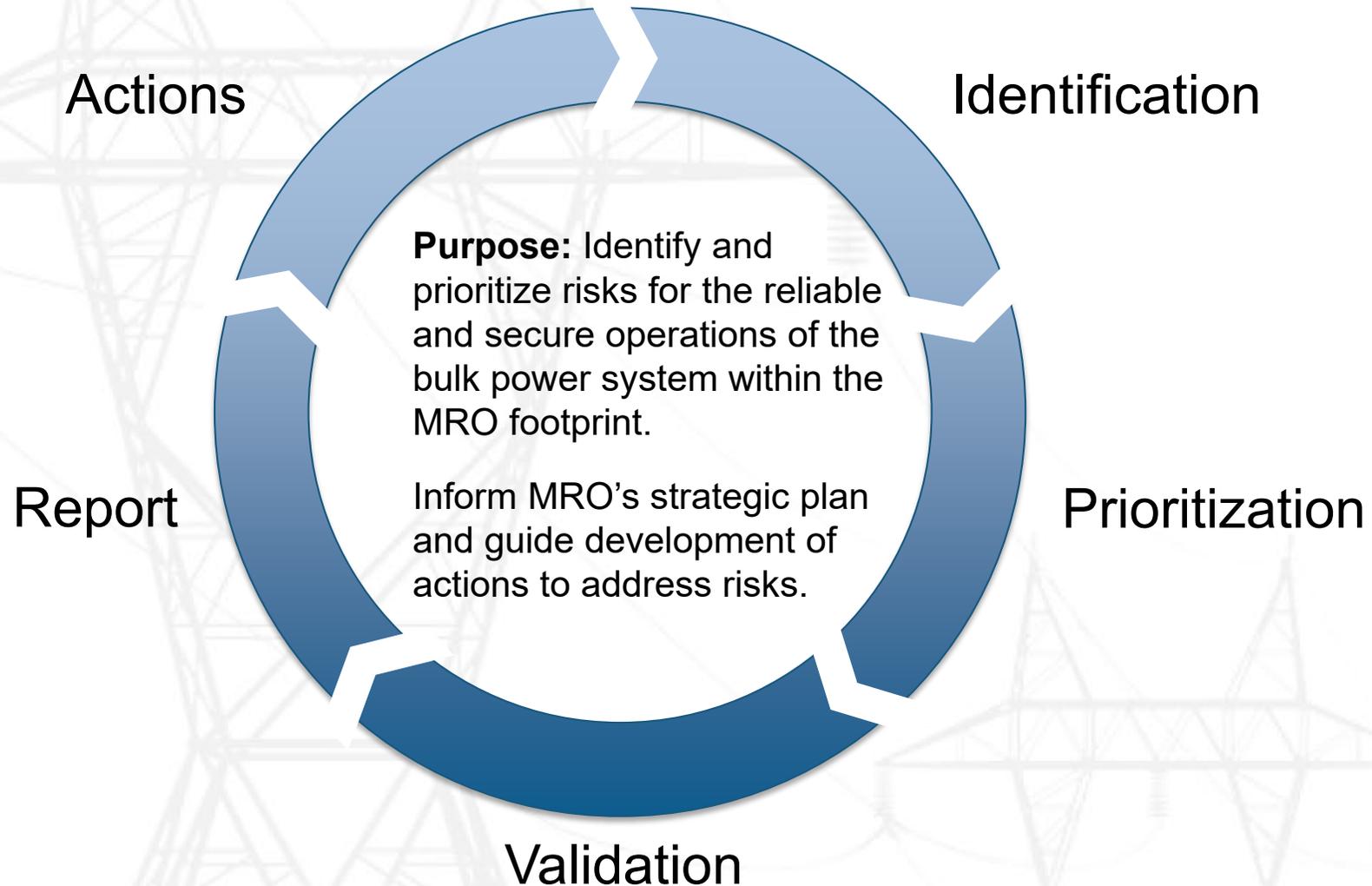


Industry Recommendations

- Review NERC level 2 alert related to cold weather preparedness and participate in MRO's voluntary Generator Winterization Program.
- Maintain situational awareness of unplanned generation outages and low wind forecasts and employ operating mitigations when needed during extreme weather conditions.
- Assess and develop new and better methods to evaluate supply adequacy, especially when a significant amount of generation capacity has an intermittent fuel source that is difficult to forecast.



MRO Regional Risk Assessment

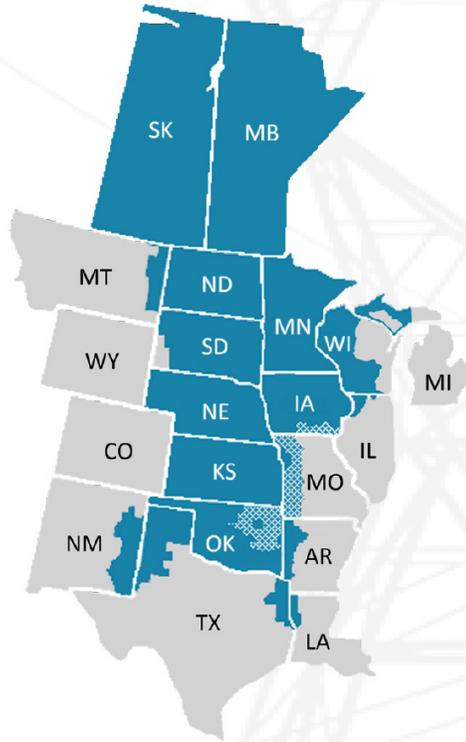




MRO 2023 Regional Risk Assessment

Top risks to the reliable and secure operation of the North American bulk power system in MRO's regional footprint.

Territory



MRO Reliability Risk Matrix: Risk Rankings

Consequence / Impact (C)		Likelihood (L)					 LOW MEDIUM HIGH EXTREME
		L1	L2	L3	L4	L5	
		Very Unlikely	Unlikely	Possible	Likely	Almost Certain	
C5	Severe						
C4	Major				4,5,6,16		
C3	Moderate		2	9,12,13	1		
C2	Minor			3,7,8,10,14,17	15		
C1	Negligible			11			

Top risks are reflected in orange above and described below. A full list of risks assessed can be found in the final report.

Assessment Overview

- Extreme weather, consumer demand, and changes in technology and generation resources continue to present a rapidly increasing number of challenges to grid planners and operators. Physical and cyber security risks also continue to evolve at an unprecedented pace.
- MRO's annual *Regional Risk Assessment* considers continent-wide risks to reliability and security of the North American bulk power system and determines which are more likely to occur and would have a higher impact in MRO's region.
- This report is focused on risk identification, prioritization and mitigation and highlights for industry the priorities needed to collaboratively address these challenges. It also serves to inform key decision makers of challenges the industry faces and the policies and regulations that will help define a variety of proposed solutions.

● [READ MRO'S 2023 REGIONAL RISK ASSESSMENT](#)

About Us

As part of the [ERO Enterprise](#), MRO is committed to a shared mission to identify, prioritize and assure effective and efficient mitigation of risks to the reliability and security of the North American bulk power system in its regional footprint.

Read more at www.MRO.net

Key Findings: Top Reliability and Security Risks in MRO's Territory

Model Assumptions	Planning Reserves	Energy Reliability	Generation Unavailability	Transmission Line Ratings	Insider Threats	Malware/Ransomware	Supply Chain Compromise
<p>RISK 1. Assumptions used in bulk power models to plan and operate the grid have not accounted for the rapid increase in inverter-based and distributed energy resources, challenging industry's ability to accurately assess current and future system characteristics.</p>	<p>RISK 4. Traditional methods to calculate Planning Reserve Margin are inadequate to properly plan for the generation capacity needed to meet increasingly uncertain system operations, especially during extreme weather events.</p>	<p>RISK 5. Increased uncertainty from changing energy supply and customer demand challenge the grid's ability to meet load for all hours of the year. There is no comprehensive planning that assesses energy and fuel sources over all time periods to maintain grid reliability.</p>	<p>RISK 6. Generation availability assumed during cold weather, particularly in the southern U.S., has been shown to be unrealistically high due to a lack of generation winterization and natural gas curtailments.</p>	<p>RISK 12. Use of constant overhead transmission line ratings year-round (non-seasonal) limits available transmission capacity and leads to inefficient real-time decisions when system conditions deviate from assumptions that drive rating calculations, such as cooler temperatures or during emergency operations.</p>	<p>RISK 9. Employees or contractors using their knowledge and authorized access of critical systems to do harm to the bulk power system is a continued, substantial threat to organizations and the reliability of the grid.</p>	<p>RISK 13. Phishing attacks can introduce malware or ransomware to corporate IT systems, which can impact critical systems necessary for reliable bulk power system operations through direct or in-direct connections those systems have to IT networks.</p>	<p>RISK 16. A cyber security event carried out through the vendor supply chain can broadly impact bulk power system reliability, especially where the vendor is a market leader providing systems used for system operation.</p>



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Conservative Practices to Calculate Planning Reserve Margin (PRM)

Consequence / Impact (C)		Likelihood (L)		
		L2	L3	L4
		Unlikely	Possible	Likely
C4	Major		2021	2022, 2023
C3	Moderate			
C2	Minor			

PRM = Margin between Anticipated Generation & Anticipated Load

To calculate PRM, need several assumptions

- **Accredited generation capacity**
- **Expected generation outages (planned and forced)**
- **Forecasted peak load**

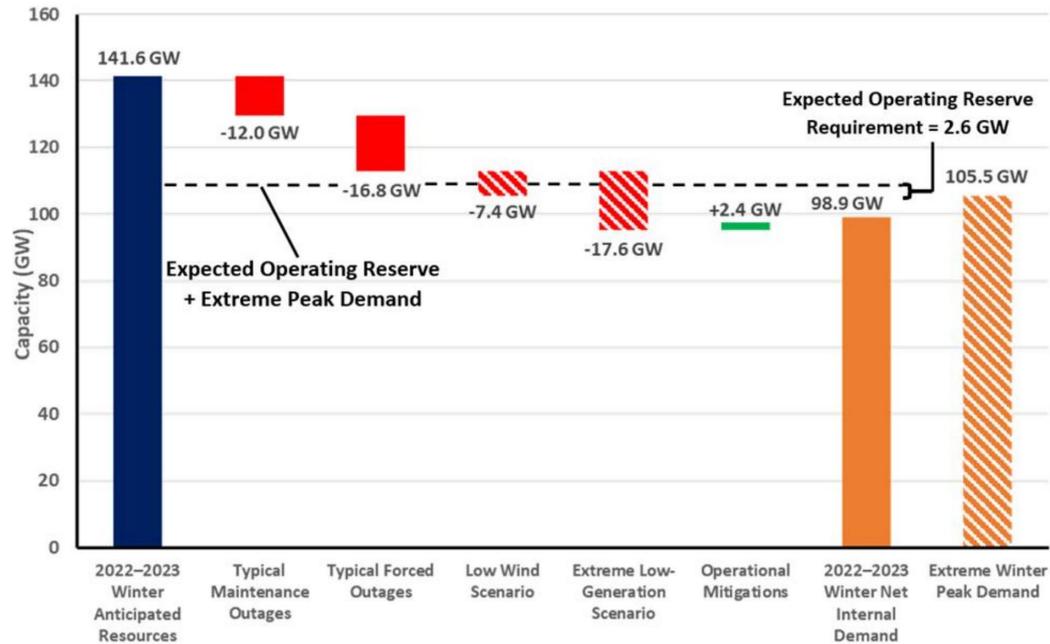


Conservative Practices to Calculate PRM

Consequence / Impact (C)		Likelihood (L)		
		L2 Unlikely	L3 Possible	L4 Likely
C4	Major		2021	2022, 2023
C3	Moderate			
C2	Minor			

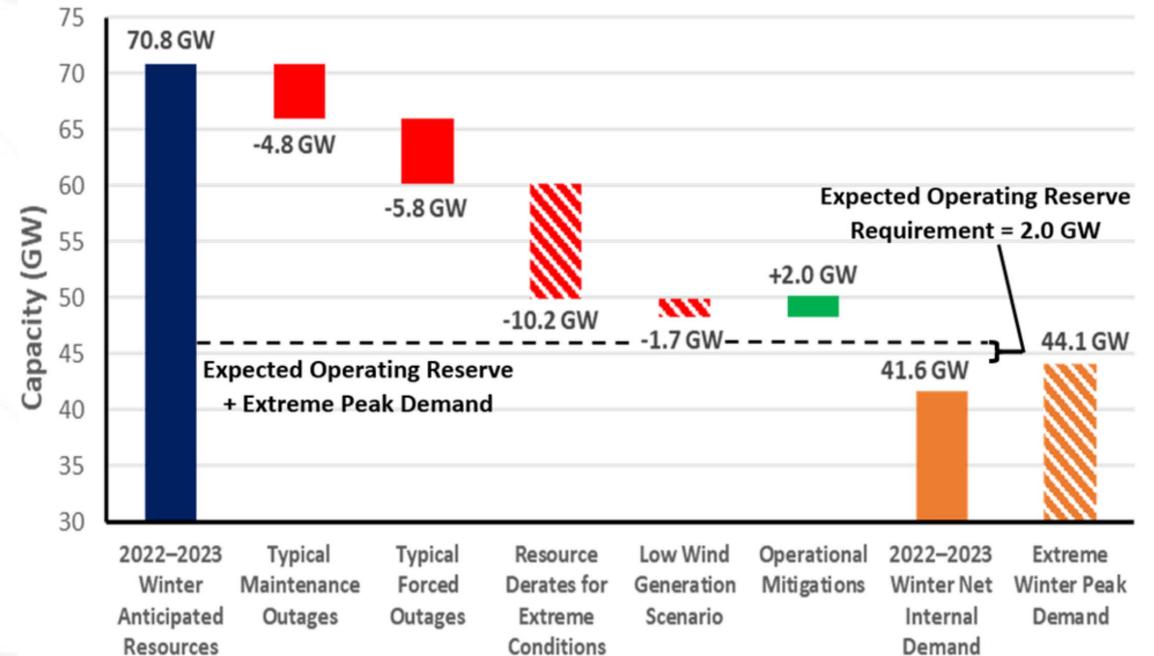
MISO Winter '22/23

Risk-Period Scenario



SPP Winter '22/23

Risk-Period Scenario



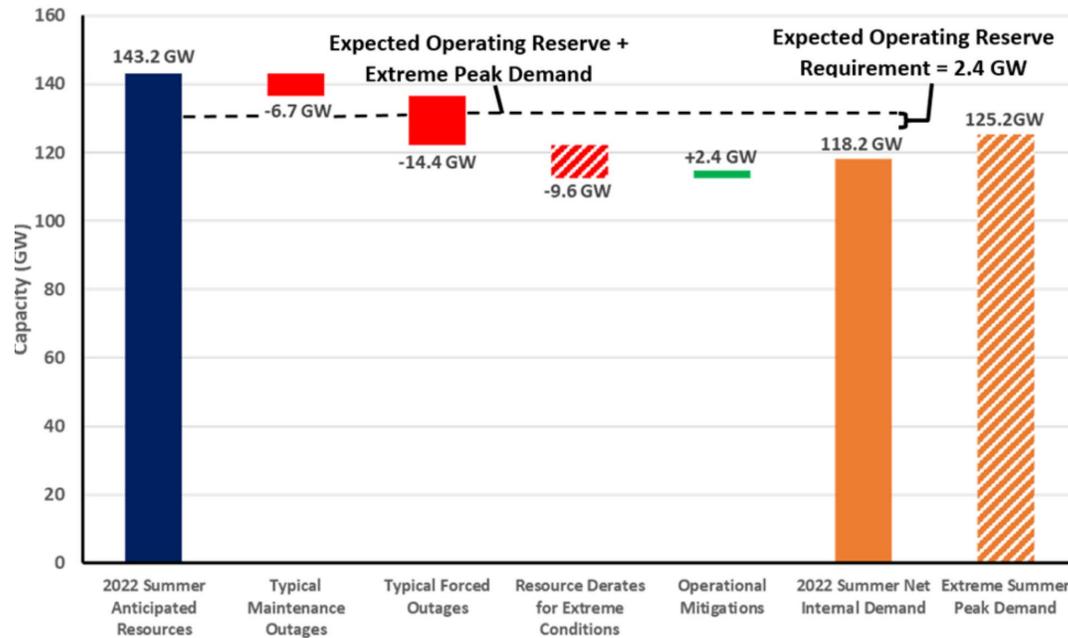
Conservative Practices to Calculate PRM

Consequence / Impact (C)		Likelihood (L)		
		L2 Unlikely	L3 Possible	L4 Likely
C4	Major		2021	2022, 2023
C3	Moderate			
C2	Minor			

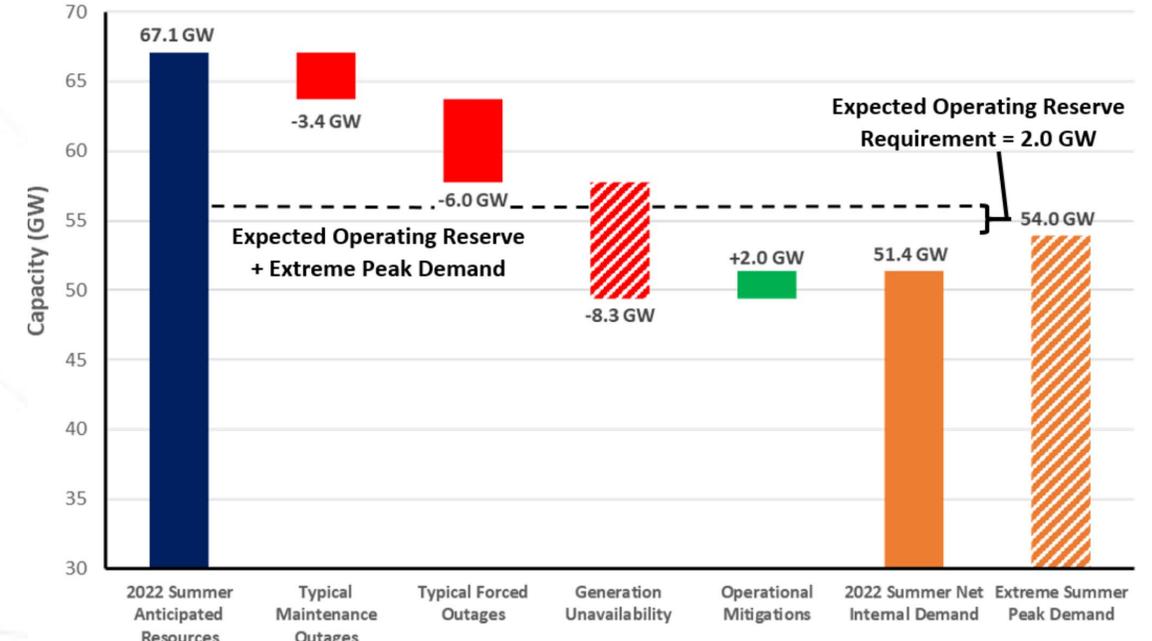
MISO Summer '22

SPP Summer '22

Risk-Period Scenario



Risk-Period Scenario



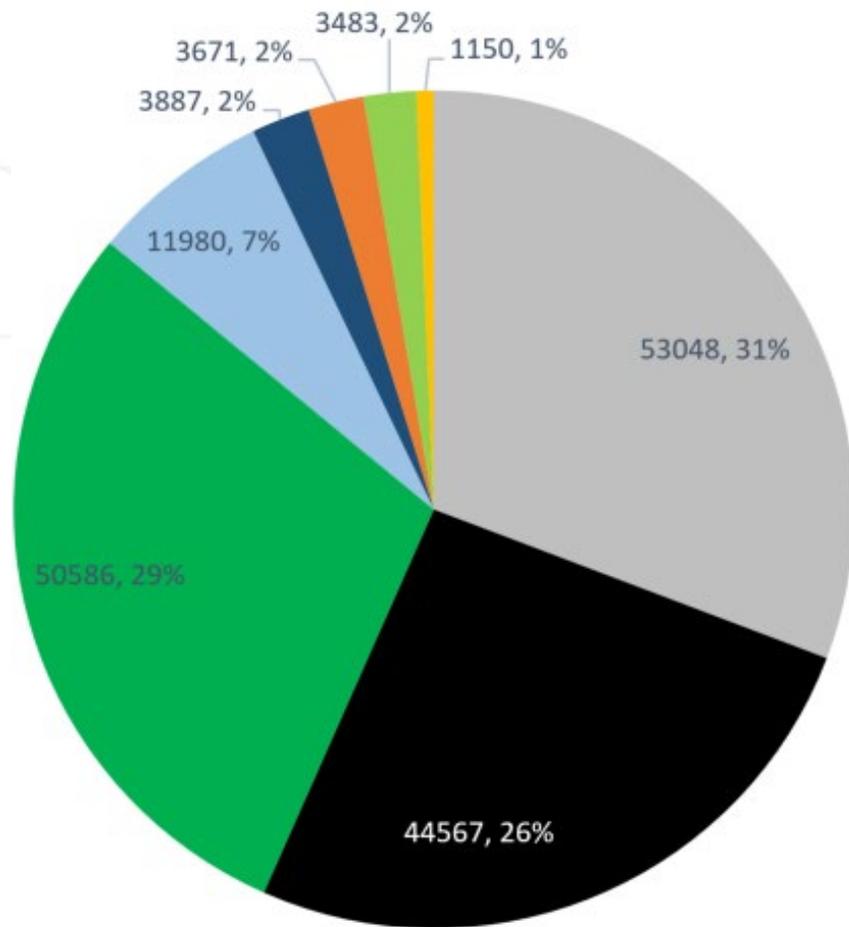
Energy Reliability Planning

- Energy availability needed for 8,760 hours a year
- Account for:
 - Unassured fuel supplies
 - Inconsistency of variable generation output
 - Volatility in forecasted load

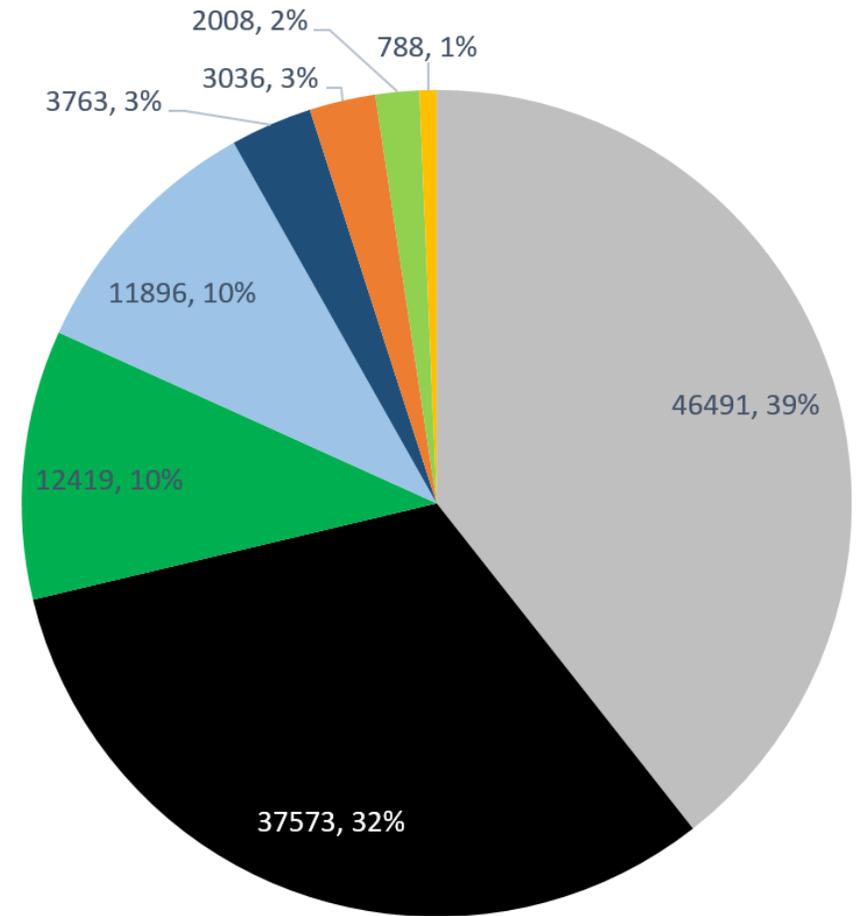
Consequence / Impact (C)		Likelihood (L)		
		L2	L3	L4
		Unlikely	Possible	Likely
C4	Major		2022	2023
C3	Moderate			
C2	Minor			



MRO Nameplate vs. Capacity



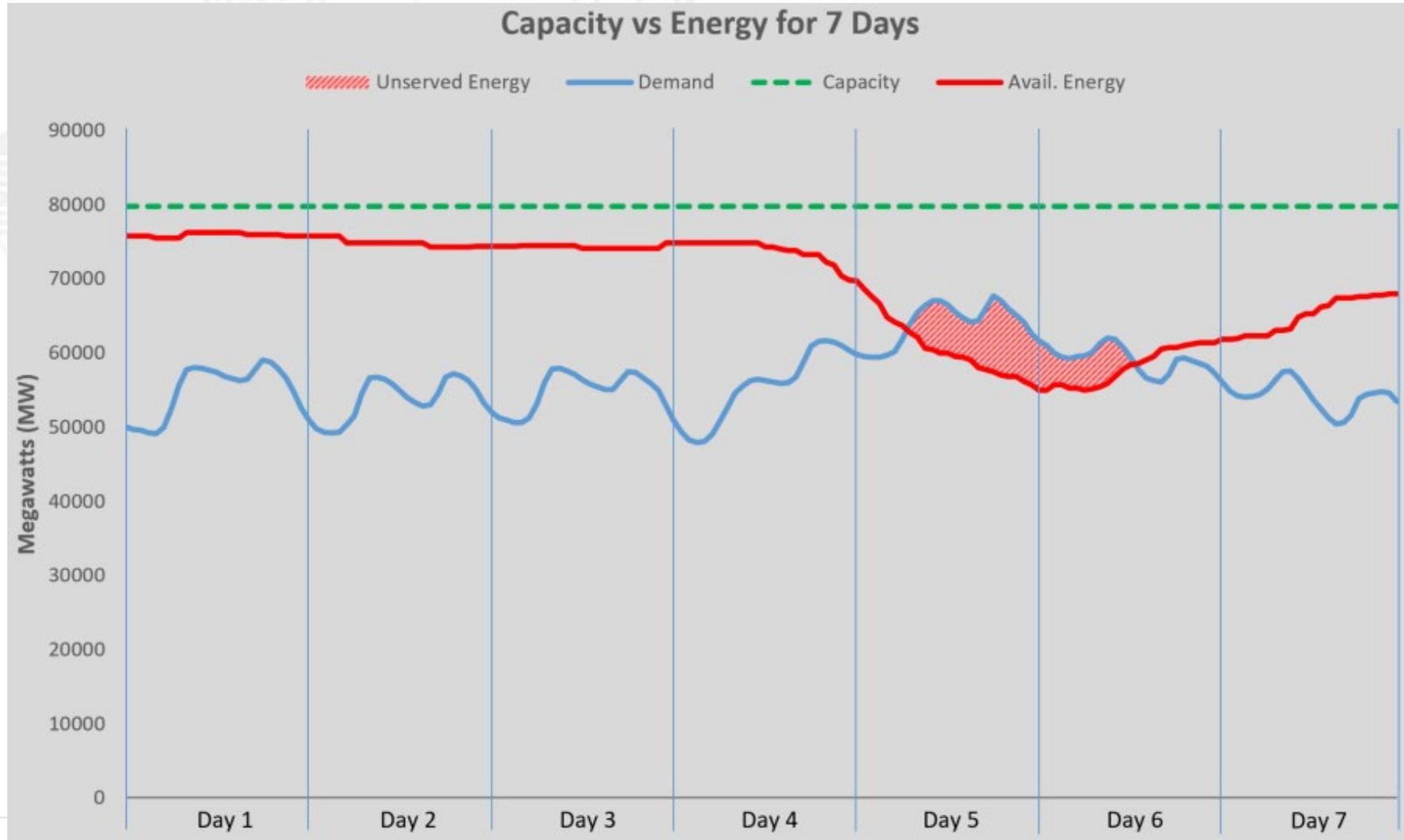
Nameplate



Capacity



Capacity ≠ Energy



Generation

Unavailability during Extreme Cold Weather

- Natural gas generation not winterized for sub-freezing temperatures (especially south-central US)
- Electric/Gas infrastructure interdependencies
- Forced outages strain energy availability to meet load

Consequence / Impact (C)		Likelihood (L)		
		L2	L3	L4
		Unlikely	Possible	Likely
C4	Major			2022, 2023
C3	Moderate			
C2	Minor			



Generation Unavailability during Extreme Cold Weather

Consequence / Impact (C)		Likelihood (L)		
		L2 Unlikely	L3 Possible	L4 Likely
C4	Major			2022, 2023
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C2	Minor			

- MRO Generator Winterization Program
- Cold Weather Preparedness Workshop
- NERC Alert: Cold Weather Preparations for Extreme Weather Events
- NAESB Gas-Electric Forum



New NERC Industry Group

Energy Reliability Assessments Task Force (ERATF)

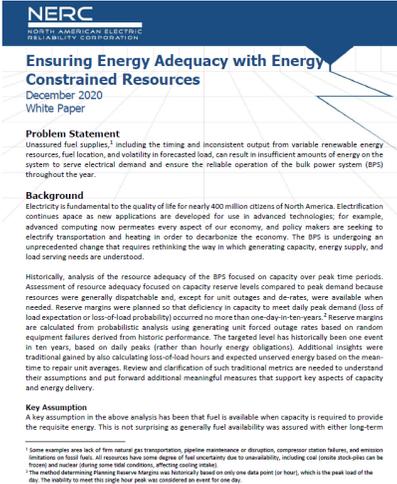
Utilities

ISOs/RTOs

EPRI

Manufacturers

ERO



RELIABILITY | RESILIENCE | SECURITY



SURVEY



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RESULTS

Overhead Transmission Line Ratings

Consequence / Impact (C)		Likelihood (L)		
		L2 Unlikely	L3 Possible	L4 Likely
C4	Major			
C3	Moderate		2023	
C2	Minor		2021, 2022	

- Seasonal and emergency ratings not fully used
- Impact of FERC Order 881-A

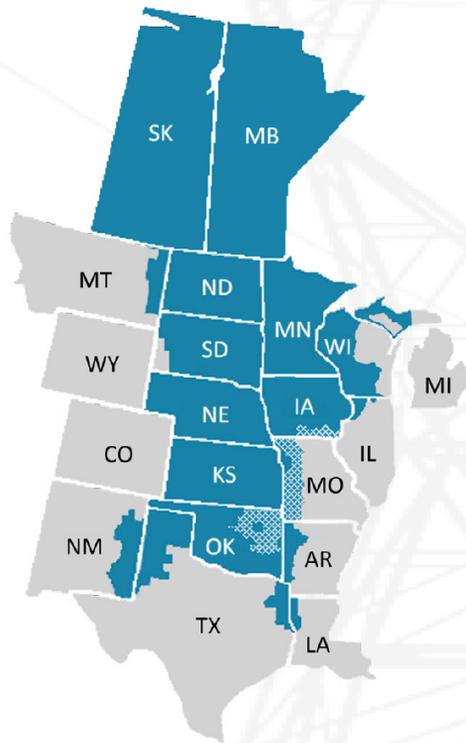




MRO 2023 Regional Risk Assessment

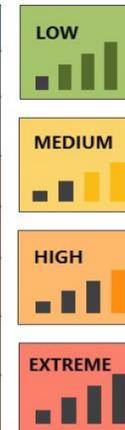
Top risks to the reliable and secure operation of the North American bulk power system in MRO's regional footprint.

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Upcoming Events

2023 Regional Risk Assessment Webinar

March 8, 2023, WebEx
10:00 to 11:00 a.m. Central

Agenda Topics

- Regional Risk Assessment Overview
- Review of the top Risks in the MRO Region
- Q&A for attendees

Presenter

Mark Tiemeier, Principle Technical Advisor,
Midwest Reliability Organization

Registration

There is no fee for attendance. Register to attend this webinar [here](#).

Registration closes on March 7, 2023.

MRO Annual Reliability Conference

May 17th, 2023 MRO Office
380 St. Peter Street, Suite 800
St. Paul, MN

In-Person or Virtual Option

Agenda Topics

- Facility Ratings Best Practices
- Battery Storage
- Human Performance

[2023 MRO Hybrid Reliability Conference - Midwest Reliability Organization](#)



References

- www.mro.net
- [2022 NERC Long Term Reliability Assessment](#)
- [2022 MRO Regional Winter Assessment](#)
- [2023 MRO Regional Risk Assessment](#)



Questions

- **Contact Information:**

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