



RTO & ISO Reliability Challenges

Chad Allen

The Energy Council – Annual Meeting

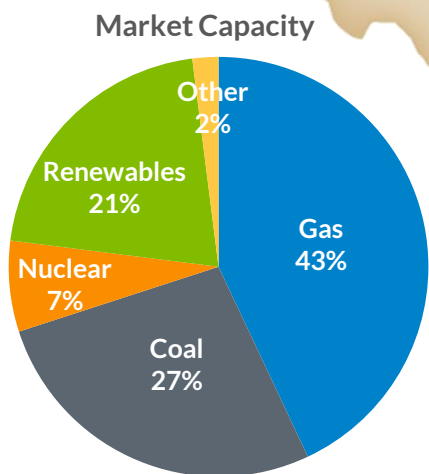
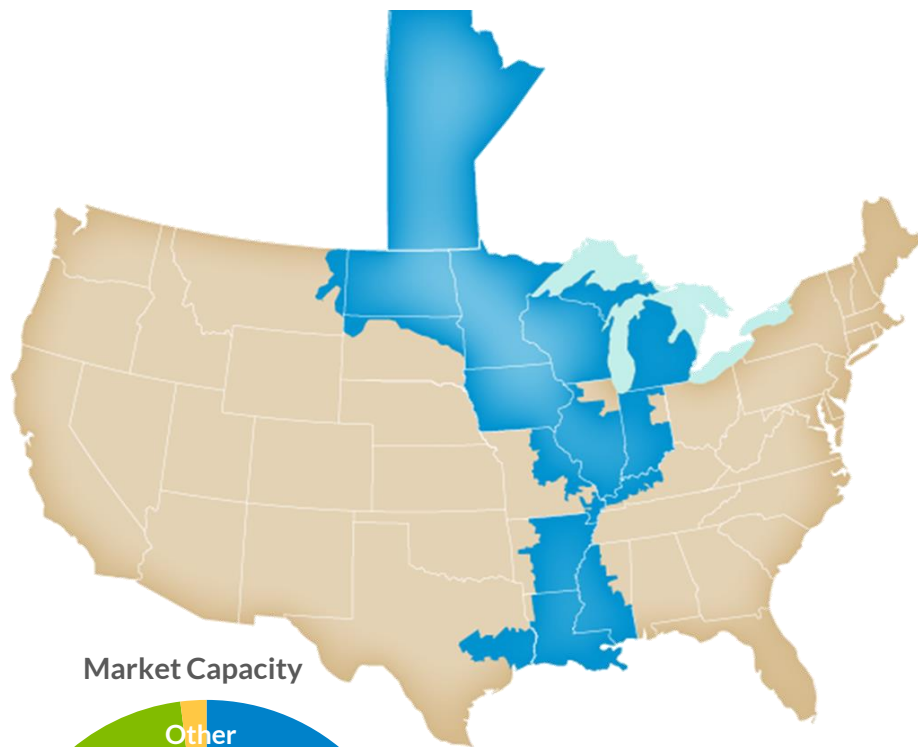
September 16, 2022

Executive Summary



- Aggressive decarbonization goals have been established across the country without detailed, coordinated implementation plans
- As the evolution of the resource fleet accelerates, variability is increasing, and attributes required to reliably operate the system are diminishing
- We must develop a coordinated transition plan to reliably navigate from the present to the future

MISO is an independent, not-for-profit Regional Transmission Organization serving 15 U.S. states and one Canadian province



What we do

- ❖ Provide independent transmission system access
- ❖ Deliver improved reliability coordination through efficient market operations
- ❖ Coordinate regional planning
- ❖ Provide a platform for wholesale energy markets

MISO by the numbers*

High Voltage Transmission	65,800 miles**
Generation Capacity	205,177 MW
Peak Summer System Demand	130,917 MW
Customers Served	42 Million

The system is evolving and will continue to evolve toward a more complex, less predictable future

Past

- Primarily controllable resources
- Ample reserve margins
- Predictable resource outages
- Relatively predictable weather
- Focus on providing energy *in the worst peak load hour* during the summer

Present

- Transitioning resource mix
- Tightening reserve margins
- Less predictable resource outages or unavailability
- Growing uncertainty in weather conditions
- Greater inter-dependence between utilities, states, and RTOs
- Focus on providing energy *on the worst day in each season*

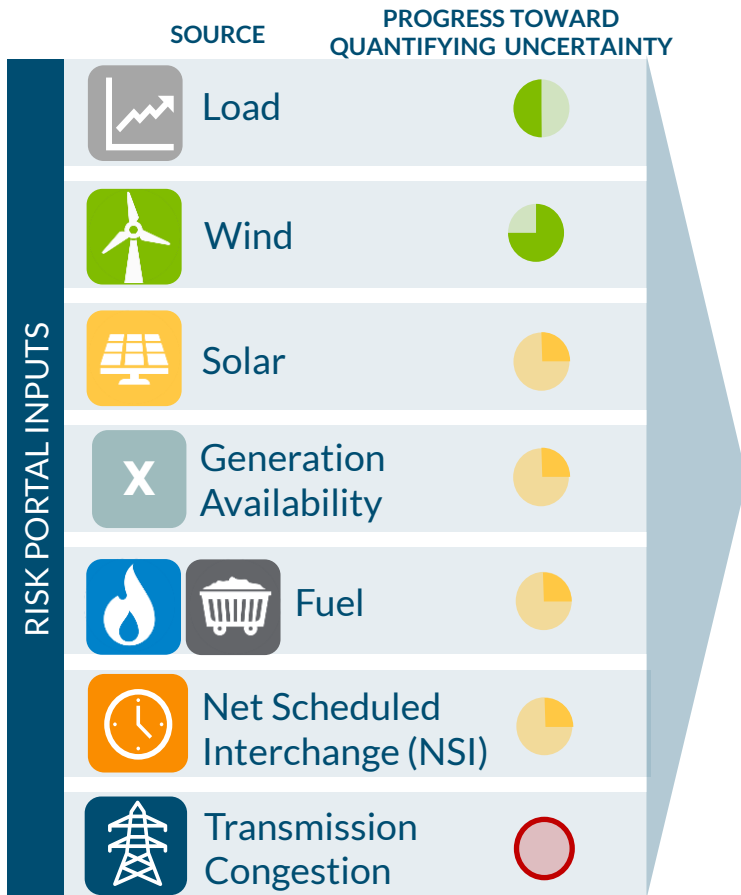
Future

- Primarily weather-dependent resources
- Risk-adjusted reserve margin requirements
- Less predictable resource outages or unavailability
- Less predictable weather
- Increasing scarcity of essential reliability attributes
- Increasing electric load
- Increasing importance of accurate load and renewable forecasting
- Focus on providing energy for *the worst week in each season*

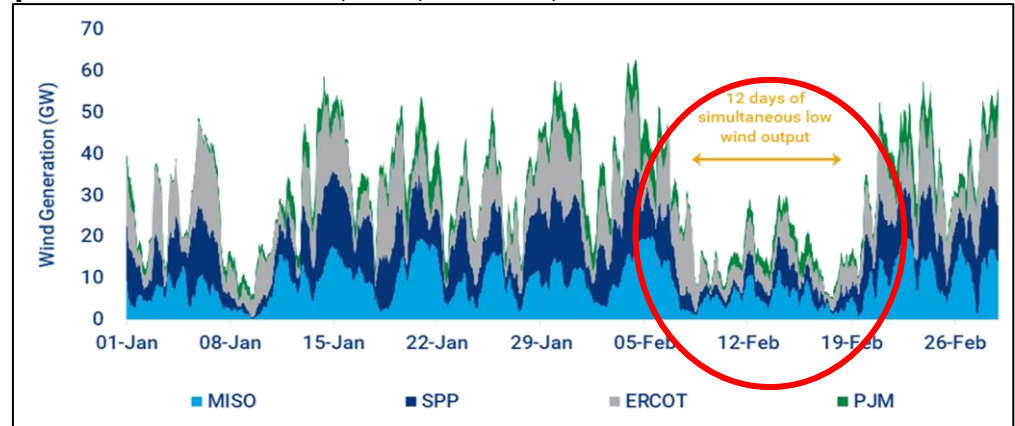
Policy drivers – such as EPA regulations; Environmental, Social, and Governance criteria; State Energy Policy; and the Inflation Reduction Act – are accelerating the fleet transition and associated risks

Variability risks must be considered to reliably evaluate and operate the system

PROBABILISTIC FORECASTS AND RISK ASSESSMENT

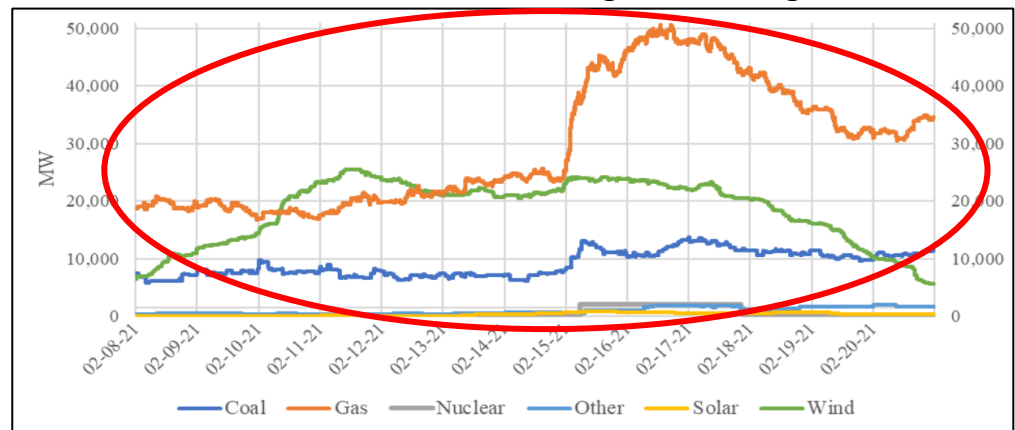


During Winter Storm Uri, wind output was low for a 12-day period across MISO, SPP, ERCOT, and PJM...



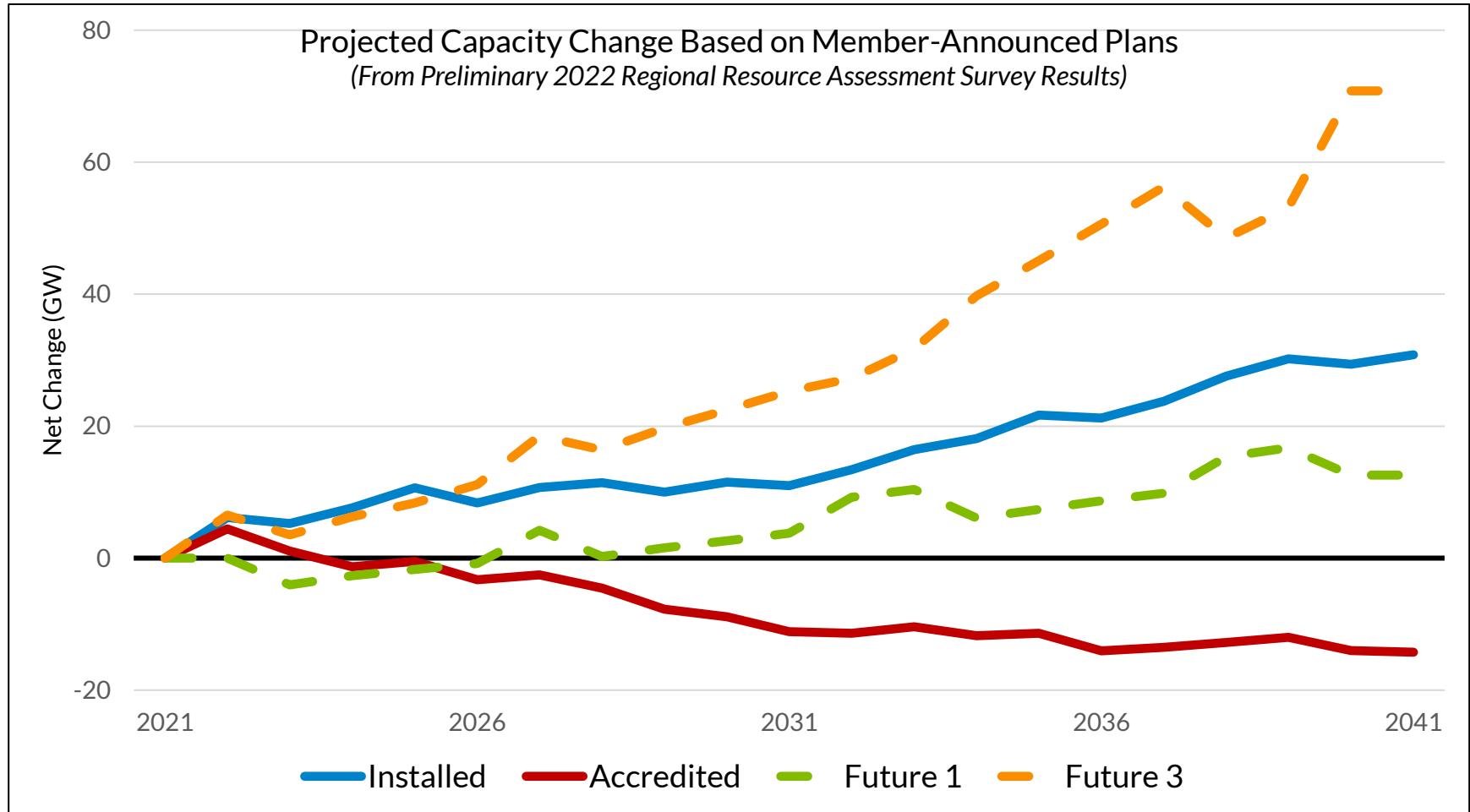
Source: Wood Mackenzie

...concurrently, all resource types in MISO South, SPP, and ERCOT experienced increased outages, totaling 455.7 GW.



Source: FERC Report on The February 2021 Cold Weather Outages in Texas and the South Central United States

Declining accredited capacity combined with growing load will exacerbate risk of supply shortfalls



*Future projections calculated as change from Future 1 2022 load assumption

Estimated accredited capacity: 16.6% for wind; 35% for solar, 87.5% for battery, 90% for coal, 90% for gas, and 95% for nuclear

Different resource types each bring a unique mix of those attributes
 - while every resource does not need to bring all attributes, the system will need an “adequate” supply of each attribute

	Attribute	Battery	Coal	Gas	LMR	Nuclear	Solar	Wind
Controllability	Ramp rate up	●	●	●	◐	◐	◐	◐
	Ramp rate down	●	●	●	◐	◐	◐	◐
	Rapid start up	●	◐	●	◐	◐	●	●
	Minimum downtime	◐	◐	●	◐	◐	●	●
Certainty	Available in all seasons	●	●	●	◐	●	◐	◐
	Fuel availability	◐	◐	◐	◐	●	◐	◐
	Energy adequacy / Output sustainability	◐	●	●	◐	●	◐	◐
	Run time limitations	◐	◐	◐	◐	●	●	●
	Inertia	◐	●	◐	◐	●	◐	◐
	Carbon reducing	?	○	◐	●	●	●	●

Key: Weak Provider of Attribute - ◐
 Strong Provider of Attribute - ●

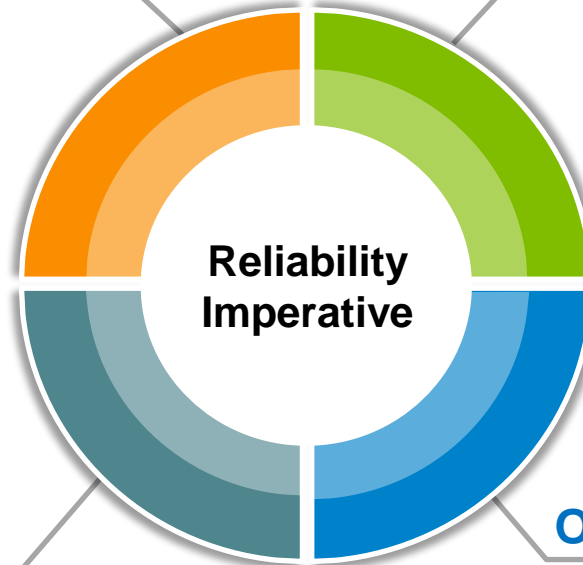
MISO's Reliability Imperative defines the changes necessary to reliably manage the changing resource portfolio

Market Redefinition

Aims to ensure that resources with needed capabilities and attributes will be available in the highest risk periods across the year

Long Range Transmission Planning (LRTP)

Assesses future transmission needs holistically, reflecting utility/state plans for new generation; will also consider potential cost-allocation changes



Market System Enhancements (MSE)

Transforms MISO's legacy platform into a flexible, upgradeable, and secure system that can evolve for years to come; will also integrate advanced technologies to process increasingly complex information

Operations of the Future

Focuses on the skills, processes, and technologies needed to ensure MISO Operations can effectively manage the grid into the future under increased complexity

We collectively need to be prudent in our actions to ensure sufficient resources and flexibility during the fleet transition

States

- Factor regional consideration into state resource adequacy, resource attribute, and market construct requirements
- Inform the broader policy and statutory discussion at the state level
- Implement NERC recommendations for resiliency and reliability

Members

- Collaborate with MISO and States on timely resource adequacy, market enhancements and regional transmission
- Share resource plans with MISO to enable accurate regional view

MISO

- Enhance transparency of resource evolution and regional outlook
- Improve Resource Adequacy construct
- Visibility into and reviewing impacts of resource retirements
- Inform the broader policy discussion with federal policymakers and agencies

Appendix

Forthcoming EPA regulations could accelerate planned coal and gas retirements and/or drive new retirements in the MISO Region



- Ozone (“smog”)
- Particulate Matter (“soot”)
- Coal ash
- Mercury & air toxics
- Wastewater discharge limits
- Visibility over national parks
- Carbon standards for existing and new coal & gas units

- Some of these regulations will impact MISO as soon as next year, while others are on longer timelines. Some may never be finalized due to electoral changes, litigation, or other factors.
- America’s Power, an industry trade group and a MISO Stakeholder, estimates these regulations could drive 30 GW of additional coal retirements in MISO that have not been publicly announced as of May 2022
- MISO will work with its stakeholders to assess the impacts of these regulations
- MISO also tracks state policies and utility aspirational goals that impact the region

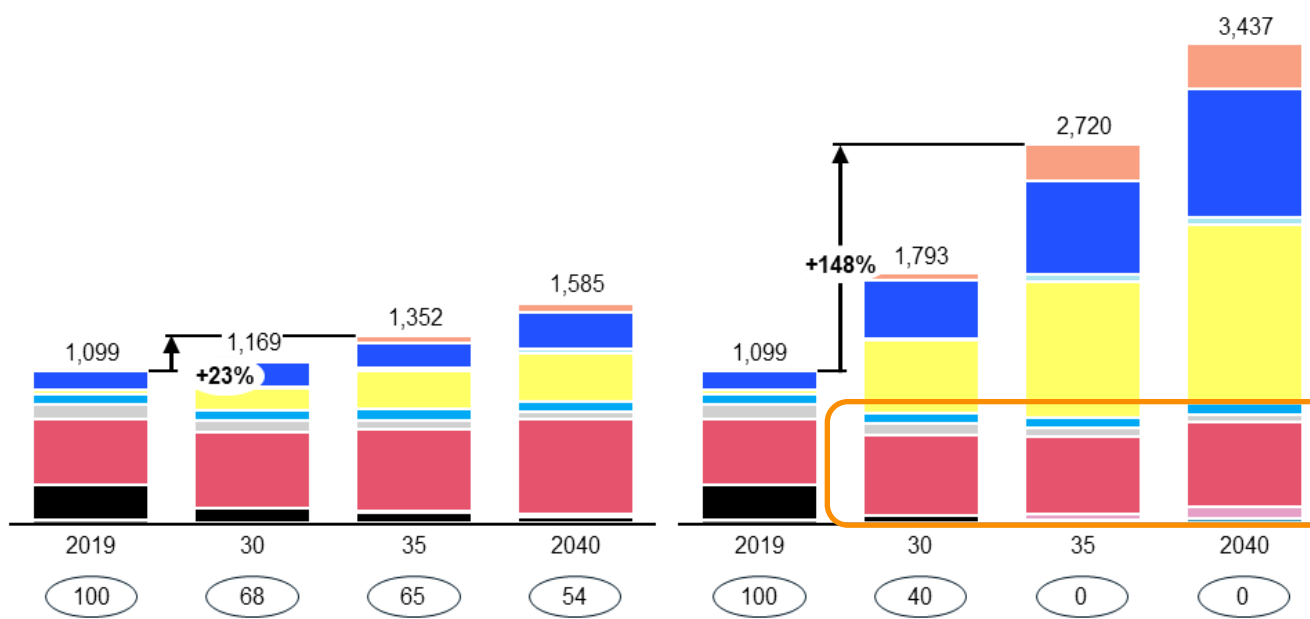
A McKinsey analysis of the U.S. power sector indicates gas will remain a critical resource – as it contains many of the attributes lacking in other resource types – but it will be utilized more rarely than in the past

Storage Offshore Wind Hydro Gas BECCS Other
 Onshore Wind Solar Nuclear Gas CCS Coal

US Installed Capacity (GW)

Current Trajectory

zero-by-2035



Takeaways

The zero-by-2035 scenario sees a more significant increase in capacity than the base case in order to meet increased electric load and produce hydrogen

Legacy nuclear plants are likely to provide <5% of power capacity in 2040

Gas remains a critical source of reliable, dispatchable power, but is utilized more rarely