RESILIENCE OF THE ELECTRIC GRID IN NORTH DAKOTA

JULY 2024

ANNUAL REPORT

NORTH DAKOTA TRANSMISSION AUTHORITY

OVERVIEW

The North Dakota Transmission Authority (Authority) was created by the North Dakota Legislative Assembly in 2005 at the request of the North Dakota Industrial Commission. The Authority's mission is to facilitate the development of transmission infrastructure in North Dakota. The Authority was established to serve as a catalyst for new investment in transmission by facilitating, financing, developing and/or acquiring transmission to accommodate new lignite and wind energy development. The Authority is a builder of last resort, meaning private business has the first opportunity to invest in and/or build needed transmission.

STATUTORY AUTHORITY

By statute, the Authority membership is comprised of the members of the North Dakota Industrial Commission. Claire Vigesaa was appointed Executive Director of the Authority on July 28, 2023. The Executive Director works closely with the Industrial Commission Administrative Office staff.

The third Annual Report on the status of the Resilience of the Electric Grid in North Dakota has been prepared as directed by the 67th legislative Assembly in Senate Bill No. 2313 and is being provided to the Legislative Council and North Dakota Industrial Commission with copies being sent to the Midcontinent Independent System Operator (MISO) and the Southwest Power Pool (SPP) and Minnkota Power Cooperative (MPC).

The resilience of the Electric Grid is dependent on the generation and transmission portion of the electric grid working together seamlessly. This report explores the adequacy of generation and the ability of the transmission system to deliver the generation to location where it is in demand. The system must also be able to withstand adverse conditions from weather events and from equipment failures.

NORTH DAKOTA INDUSTRIAL COMMISSION

DOUG BURGUM
Governor

DREW H. WRIGLEY
Attorney General

DOUG GOEHRING
Agriculture Commissioner

NORTH DAKOTA TRANSMISSION AUTHORITY

CLAIRE VIGESAA
Executive Director
ND Transmission Authority

ELECTRIC RESILIENCE DEFINED:

They define electric resilience as the ability of the system and its components (both equipment and human) to (1) prepare for, (2) anticipate, (3) absorb, (4) adapt to and (5) recover from non-routine disruptions, including high impact-low frequency (HILF) events in a reasonable amount of time.

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EXECUTIVE SUMMARY

Electric supply and demand must always be balanced to maintain relatively constant frequency and voltage. During normal operations, small changes in demand occurring in each moment must be matched by corresponding changes in resource output to maintain balance. If the supply-demand gap becomes too large, this imbalance could lead to emergency operations of the grid. In extreme cases, outages and damage to equipment or appliances could occur.

Every machine, technology and software supplying electricity makes different contributions to grid reliability. Not every resource must provide all types of reliability services, but the entire portfolio must be able to respond appropriately to keep the grid in balance.

To maintain stability, each service available in the portfolio acts in a particular time frame. Fast frequency response occurs in the seconds immediately following a disturbance to slow decline and is followed by primary frequency response which stabilizes frequency. Economic dispatch operates at a five-minute time steps while longer time steps are typically managed by automatic or manual dispatch through market mechanisms.

When major disturbances occur, sufficient disturbance ride-through capabilities to maintain frequency and voltage are needed to keep resources running through instability.

Traditionally, grid operators obtained services from large thermal units and rotating machines such as coal-fired, nuclear, or hydro-electric power plants for stability. The physical attributes of these generation sources provided valuable grid enhancing service. Their large spinning mass provides inertia, contributing to stability. The proposed retirement of dozens of coal plants is raising concerns about the ability to operate the grid without the significant grid enhancing attributes of the large spinning generator mass.

North Dakota investor-owned utilities and cooperatives have a strong history of building and maintaining a dependable grid. The utilities and our communities face challenges to keep the grid reliable in the face of pressures from EPA on fossil fuel generation coupled with the growth in electrical demand for data centers, electrification, increased domestic manufacturing and general economic growth.

RISKS TO GRID RELIABILITY

The North American Electric Reliability Corporation (NERC) has identified five significant evolving and interdependent risks to grid reliability. Those five include:

Energy Policy: With increase legislative focus on decarbonization, decentralization and electrification, energy policy is expected to drive rapid change. NERC emphasizes that there is great need to increase coordination and collaboration among all policy makers, regulators as well as the operators and owners of the bulk electric system. With the higher proportion of variable and renewable fueled resources, resource adequacy and capacity accreditation must be critically assessed.

Grid Transformation: NERC recommends that operators ensure sufficient operating flexibility; ensuring that flexible ramping/balancing capacity is available to meet the changing patterns of variability and new characteristics of system performance.

Extreme Weather Events: As for extreme weather events, NERC recommends that grid operators conduct special assessments of extreme event impacts and creating simulation models to establish protocols/procedures for system recovery and resiliency. Further, planning and construction of transmission infrastructure should be accelerated.

Security: To combat both physical and cyber security threats, recommendations include the facilitation/development of planning approaches, models, and simulation to reduce the number of critical facilities. Ultimately mitigating impacts relative to the exposure to attacks.

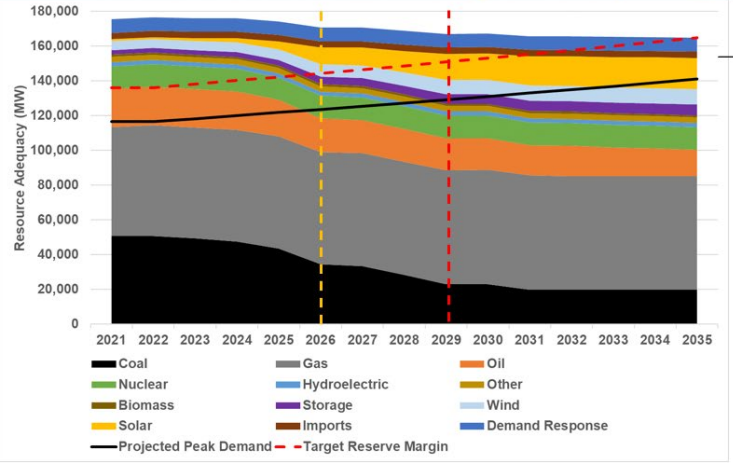
Critical Infrastructure Interdependencies: Recent storm events have exposed weaknesses in the coordination of natural gas supplies as well as water resources and digital communications.

GRID RELIABILITY – GENERATION RESOURCE ADEQUACY STUDIES

The NDTA commissioned three studies this past year. Two of the studies were focused on grid reliability and generation resource adequacy, a response to EPA's proposed MATS and Final Carbon Rule. Both studies indicated dire consequences to grid reliability due to the forced closure of dispatchable coal generation units. The following graph demonstrates the impact in the MISO footprint from the proposed MATS rule, click link here. The graph shows that MISO becomes reliant upon wind, solar, imports or demand response to meet its target reserve margin in 2026, but MISO would still have enough dispatchable capacity to meet its projected peak demand. The percentage of MISO's projected peak demand that will be met by dispatchable resources in 2028 falls to 104 percent in the Full scenario, reflecting the loss of 2,264 MW of lignite power plants in North Dakota.

In this scenario, the MISO region will no longer have enough dispatchable capacity to meet its projected peak demand in 2029, and it will rely on non-dispatchable resources, imports or storage to meet its target reserve margin.

Full Scenario RA is Maintained by Replacing Retiring Capacity with New Resources Using EPA Capacity Values, But…



Year	% Intermittent	% Storage	% Dispatchable
2023	6%	2%	131%
2024	7%	2%	128%
2025	9%	3%	122%
2026	13%	4%	112%
2027	14%	4%	109%
2028	16%	4%	104%
2029	18%	4%	98%
2030	18%	4%	97%
2031	19%	5%	92%
2032	19%	4%	91%
2033	19%	4%	89%
2034	19%	4%	87%
2035	19%	4%	85%

Estimated firm capacity using EPA's accreditation values for wind, solar, storage (100%), and thermal resources (100%). EPA assumes a 16.8 percent reserve margin. Different than MISO cleared UCAP (unforced [accredited] capacity). Red indicates intermittent generation is necessary to meet Target Reserve Margins. The rest of the reserve margin not covered in the table consists of load modifying resources.

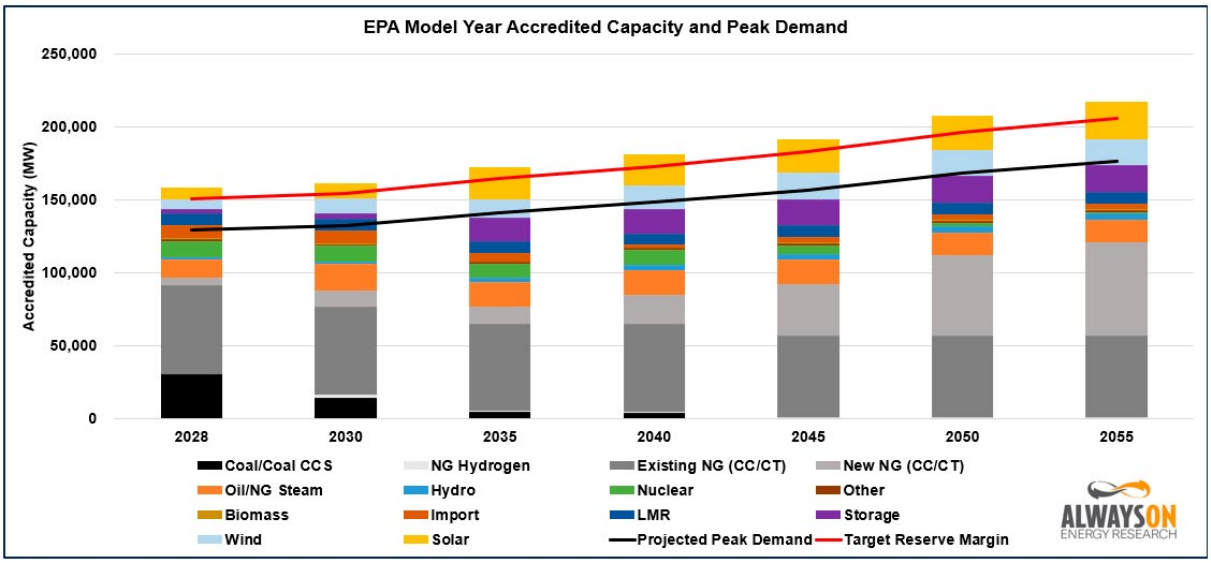
- *2023 – 2025: Adequate dispatchable capacity*
- *2026 – 2028: Reserve margin depends on W/S/B*
- *2029 – 2035: Peak Demand depends on W/S/B*

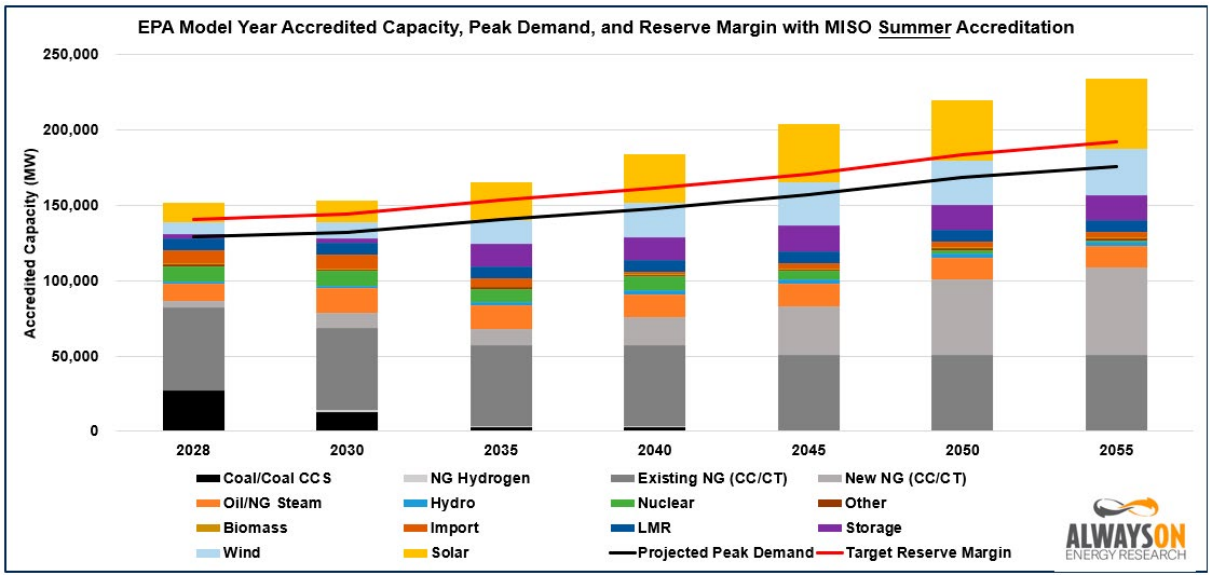
The amount of dispatchable capacity available to meet projected peak demand in 2028 falls to 104 percent in the Full scenario, reflecting the closure of all the lignite capacity in MISO that year.

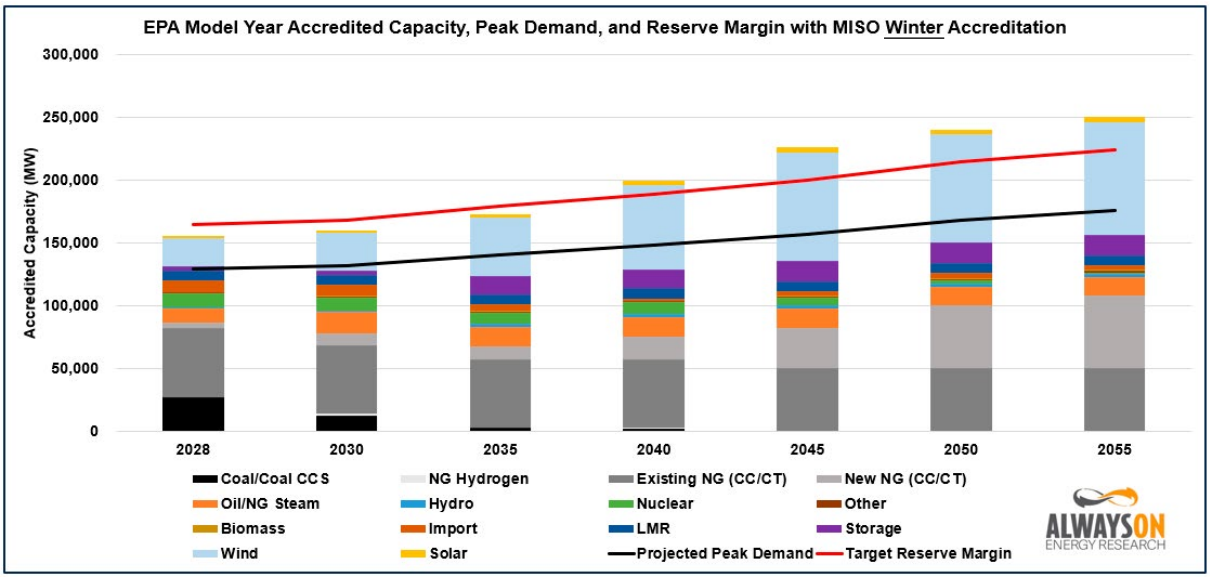
The NDTA also commissioned a grid impact study upon both MISO and SPP, click link here, with respect to the EPA's proposed Final Carbon Rule. The primary finding, which is drawn substantially from the Rule's administrative record, finalized rule and regulatory impact analysis, is not technologically feasible for lignite-based power generation facilities, will foreseeably result in the retirement of lignite power generation units, and will negatively impact consumers of electricity in the Midcontinent Independent Systems Operator (MISO) and Southwest Power Pool (SPP) systems by reducing the reliability of the electric grid and increasing costs for ratepayers. The analysis builds upon grid reliability data and forecasts from the Federal Energy Regulatory Commission (FERC) and the North American Electric Reliability Corporation (NERC), and it assesses what is likely to happen to grid reliability if the Greenhouse Gas Rule forces some or all of North Dakota's lignite power generation units to retire. We determined that the closure of lignite-fired powered power plants in the MISO & SPP footprints would increase the severity of projected future capacity shortfalls, i.e. rolling blackouts, in the MISO & SPP systems even if these resources are replaced with wind, solar, battery storage, and natural gas plants. In reaching that determination, we have accepted EPA's estimates for capacity values of intermittent and thermal resources.

Moreover, building such replacement resources would come at a great cost to MISO and SPP ratepayers. Replacing the retired coal, natural gas, and nuclear units in EPA's modeled MISO grid with the new wind, solar, battery storage, and natural gas facilities would cost an additional $381.9 billion through 2055 compared to the current operating costs of the existing fleet.

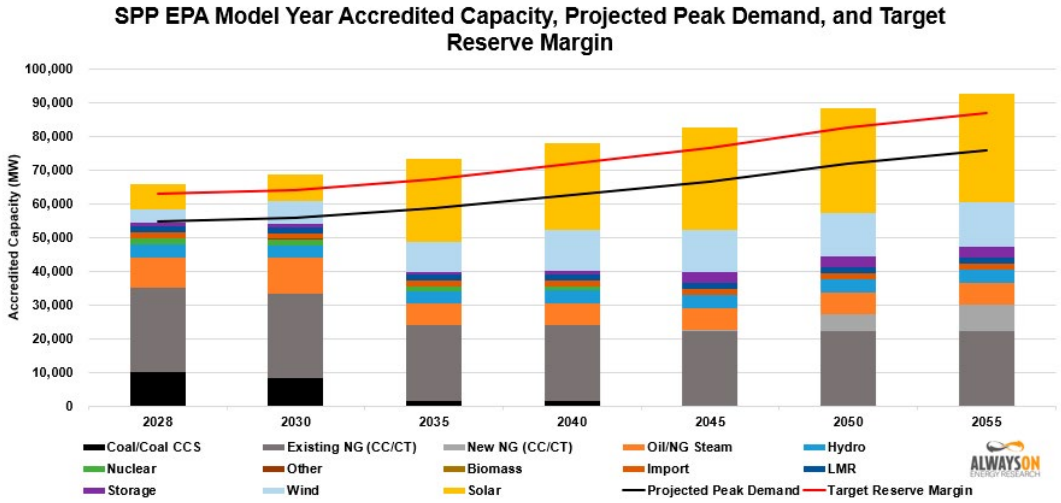
In SPP, replacing the retired coal, natural gas, and nuclear units in EPA's modeled grid with the new wind, solar, battery storage, and natural gas facilities would cost an additional $65.6 billion compared to the costs of operating the existing generation fleet.


EPA Model Year Accredited Capacity and Peak Demand
Accredited Capacity (MW)
250,000
200,000
150,000
100,000
50,000
0
2028
2030
2035
2040
2045
2050
2055
Coal/Coal CCS
NG Hydrogen
Existing NG (CC/CT)
New NG (CC/CT)
Oil/NG Steam
Hydro
Nuclear
Other
Biomass
Import
LMR
Storage
Wind
Solar
Projected Peak Demand
Target Reserve Margin
ALWAYSON
ENERGY RESEARCH

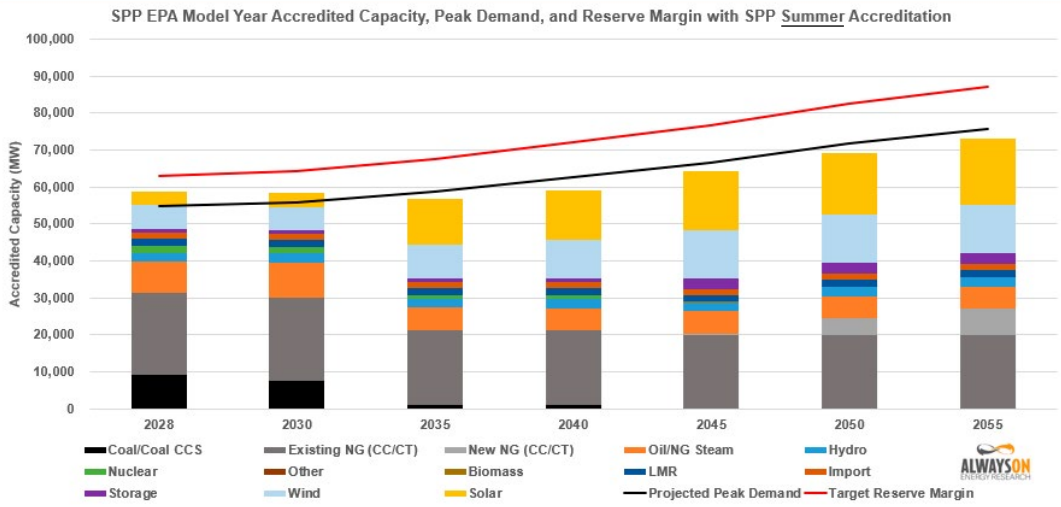

EPA Model Year Accredited Capacity, Peak Demand, and Reserve Margin with MISO Summer Accreditation
Accredited Capacity (MW)
250,000
200,000
150,000
100,000
50,000
0
2028
2030
2035
2040
2045
2050
2055
Coal/Coal CCS
NG Hydrogen
Existing NG (CC/CT)
New NG (CC/CT)
Oil/NG Steam
Hydro
Nuclear
Other
Biomass
Import
LMR
Storage
Wind
Solar
Projected Peak Demand
Target Reserve Margin
ALWAYSON
ENERGY RESEARCH


EPA Model Year Accredited Capacity, Peak Demand, and Reserve Margin with MISO Winter Accreditation
Accredited Capacity (MW)
300,000
250,000
200,000
150,000
100,000
50,000
0
2028
2030
2035
2040
2045
2050
2055
Coal/Coal CCS
NG Hydrogen
Existing NG (CC/CT)
New NG (CC/CT)
Oil/NG Steam
Hydro
Nuclear
Other
Biomass
Import
LMR
Storage
Wind
Solar
Projected Peak Demand
Target Reserve Margin
ALWAYSON
ENERGY RESEARCH

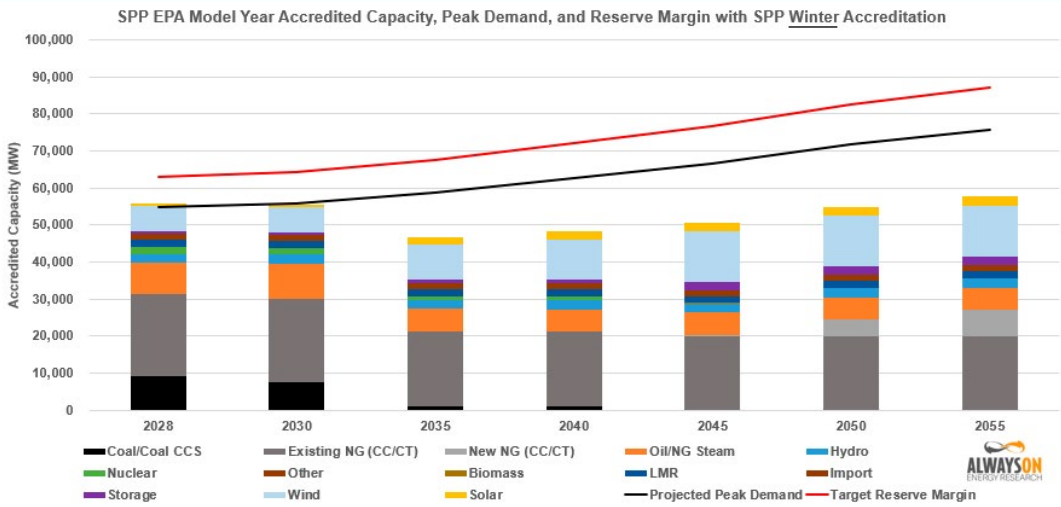
"Firm" Capacity Using EPA's Accreditation



EPA "Firm" Capacity Using SPP Accreditation in Summer



EPA Accredited Capacity Using SPP Accreditation in Winter



TRANSMISSION CAPACITY STUDY

Power Systems Engineering (PSE) was commissioned to complete a North Dakota Transmission Capacity Study. The first phase of the study included research into available recent transmission studies covering North Dakota. PSE reviewed those studies, identified projects, and formulated conclusions based on the results. Included in this phase was a summary of the currently proposed generation and transmission projects in the state and their reported impact on ND transmission capacity.

The second phase of the study focuses on key analyses of ND transmission capacity: steady-state powerflow analysis and optional dynamic stability analyses. PSE will develop near-term, and long-term transmission models to perform steady-state assessments of ND transmission capacity. The study is to be completed in the 3rd quarter of 2024.

REGIONAL TRANSMISSION ORGANIZATION (RTO) WORK ON GENERATION RESOURCE ADEQUACY & GRID RELIABILITY

SOUTHWEST POWER POOL (SPP)

Over the last year, SPP set its sights on advancing the Aspire 2026 strategic plan and achieving key corporate goals, including improving grid resilience, reforming its generator interconnection study processes, and mitigating resource adequacy risks.

Historically, SPP's approach to ensuring resource adequacy has required load-responsible entities to demonstrate that sufficient accredited capacity will be available to meet peak demand and an incremental planning reserve margin. Acknowledging that SPP and its stakeholders must adapt with a changing energy landscape, the organization took major strides in 2023 to assess and modernize its resource adequacy approach.

In a joint effort with the Regional State Committee of state regulators, Board of Directors, and stakeholders, SPP created the Resource and Energy Adequacy Leadership Team (REAL Team) to expeditiously address strategic resource adequacy policies. The team developed a multi-year work plan and has already implemented several resource adequacy improvements:

- Established a framework to create a separate winter season resource adequacy requirement.
- Approved a policy that clarifies expectations for generator availability.
- Created a method to ensure entities can comply with the increased planning reserve margin without overly punitive penalties.
- Completed the 2023 probabilistic study to determine the next summer and winter planning reserve margin requirements.
- Created new policies to change how SPP accredits conventional and renewable generators to ensure energy is available when the system needs it. Conventional generators will be accredited based on past performance, while renewables will be accredited based on how much demand they can effectively serve.
- Improved generation outage policies to allow additional days when SPP can reliably take outages.
- Enhanced transmission planning models to account for new demand and unlock additional capacity during extreme conditions.
- Developed an estimate for the "value of lost load" within the region and evaluating use cases within Resource Adequacy and Transmission Planning for the metric. A "value of lost load" metric represents how much customers would be willing to pay to avoid an outage.

The REAL team's work continues with an ambitious workplan for the next few years to implement further policy improvements.

MIDCONTINENT INDEPENDENT SYSTEM OPERATOR (MISO)

MISO has been working on several fronts to address generation resource adequacy and grid reliability. MISO established a Seasonal Capacity Auction in April 2023. This auction is held once a year for each season. MISO has also proposed a Reliability Based Demand Curve that is pending at FERC. MISO changed the market rules/construct to ensure that there is a 'slope' to the demand curve (so, capacity prices increase as we get tighter in the capacity market) instead of what MISO had previously – which was a 'vertical' demand curve. Prices were either 1) extremely low ($2MW/Day) in a surplus market, or 2) the highest price allowed – Cost of New Entry ($236.66 MW/Day) when MISO was short. If FERC provides a favorable outcome, MISO would implement the capacity market changes in the 2025/2026 planning year.

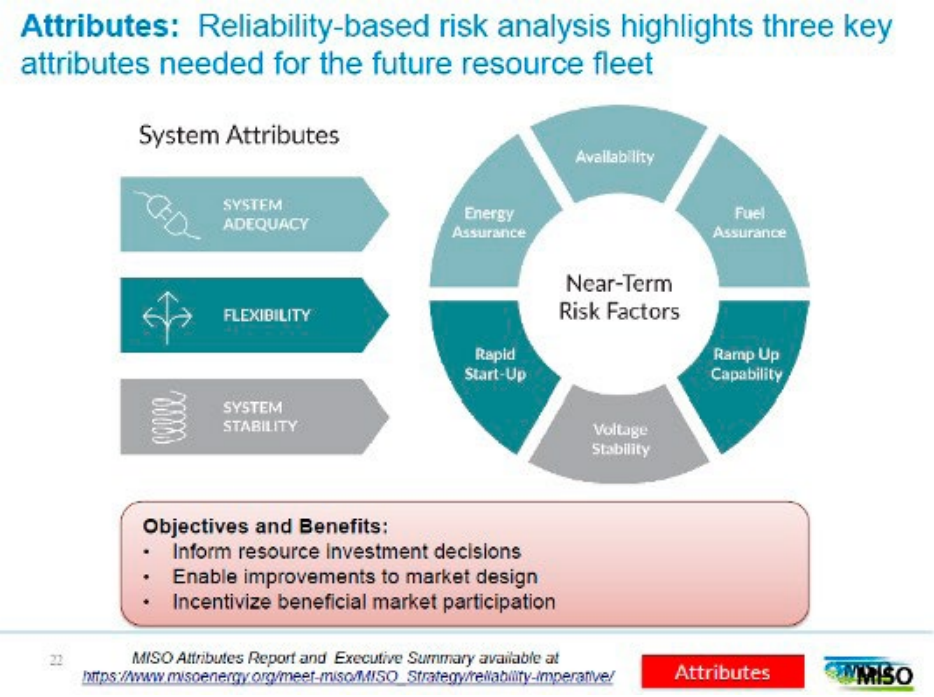
MISO has also proposed changes as to how they accredit resources based on two factors, how the class of resources performs, and then specifically – how well the individual unit performance does during the times MISO needed the resources. This is proposed for all resources type except some demand response. Previously, and when MISO was capacity long, the calculation was varied by resource type and was not as refined. Solar, for example, was given an accreditation of 50%. As the resource mix and times of need is becoming for specific, different, and varied – MISO is narrowing in on more refined calculation.

Because the equation allows for a more 'tightened' calculation of what is needed, even though resources are given a lower accreditation value, the total 'need' and amount need will likely decrease (making this change likely MW neutral across the footprint, however, some utilities will need more, and some less capacity MWs depending on their system mix). MISO has filed at FERC in March 2024 for implementation in the 2028/2029 planning year.

MISO is also addressing Resource Accreditation for Load Modifying Resources (LMR), a specific type of Demand Response. MISO has recently released to stakeholders it's proposal to change accreditation for load modifying resources in the MISO footprint. This change is controversial and affects another potential 'up to' 12 GW on the MISO system. MISO is planning to file at FERC in 3rd quarter 2024 – but is hearing feedback from stakeholders currently. MISO wants to limit load modifying resource (turning down your load) to those that can respond in 30 minutes, where today, it's up to six hour response time.

MISO issued a Attributes Roadmap last in 2023. In the report, MISO identified three major areas of action - System Adequacy, Flexibility, and System Stability as near term actions/needs. MISO further called out 27 areas of action and referred each to MISO subgroups to work on over the next few years:

- System Adequacy (10 Tasks) – Modernize the resource adequacy construct
- Flexibility (7 Tasks) – Focus market signals on emerging flexibility needs
- Voltage Stability (10 Tasks) – Require capabilities to strengthen the grid



NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

The North American Electric Reliability Corporation (NERC) is a not-for-profit international regulatory authority whose mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid. NERC develops and enforces Reliability Standards; annually assesses seasonal and long-term reliability; monitors the bulk power system through system awareness; and educates, trains, and certifies industry personnel. NERC's area of responsibility spans the continental United States, Canada, and the northern portion of Baja California, Mexico. NERC is the Electric Reliability Organization (ERO) for North America, subject to oversight by the Federal Energy Regulatory Commission (FERC) and governmental authorities in Canada. NERC's jurisdiction includes users, owners, and operators of the bulk power system, which serves nearly 400 million people.

Each year, NERC is responsible for independently assessing and reporting on the overall reliability, adequacy, and associated risks that could impact the upcoming summer and winter seasons as well as the long-term, 10-year period. As emerging risks and potential impacts to reliability are identified, special assessments are conducted that provide similar technical framework and insights about the range and specific aspects of these to guide steps that may be warranted. Unbiased judgment of industry's plans for maintaining electric reliability in the future are founded on solid engineering through collaborative and consensus-based assessments.

By identifying and quantifying emerging reliability issues, NERC is able to provide risk-informed recommendations and support a learning environment for industry to pursue improved reliability performance. These recommendations, along with the associated technical analysis, provide the basis for actionable enhancements to resource and transmission planning methods, planning and operating guidelines, and NERC Reliability Standards. The following two graphics represent risk assessments for the nation, winter and summer.

WINTER RELIABILITY RISK AREA SUMMARY – 2023-2024

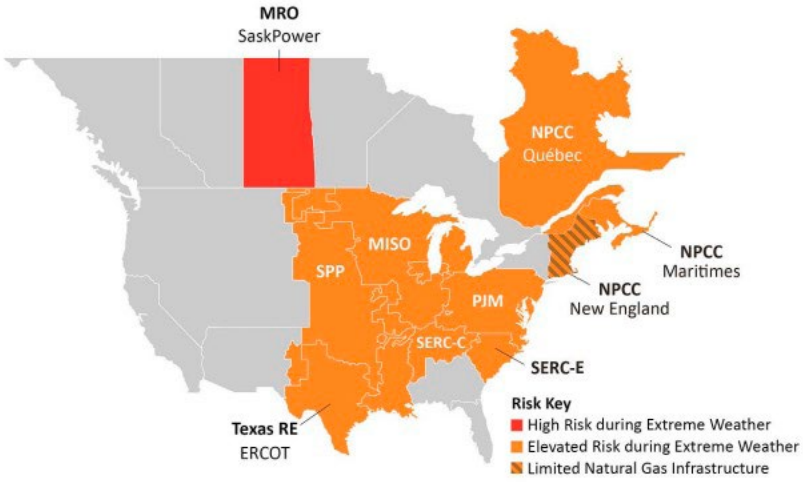


Figure 1: Winter Reliability Risk Area Summary

Seasonal Risk Assessment Summary	
High	Potential for insufficient operating reserves in normal peak conditions
Elevated	Potential for insufficient operating reserves in above-normal conditions
Low	Sufficient operating reserves expected

SUMMER RELIABILITY RISK AREA SUMMARY – 2024

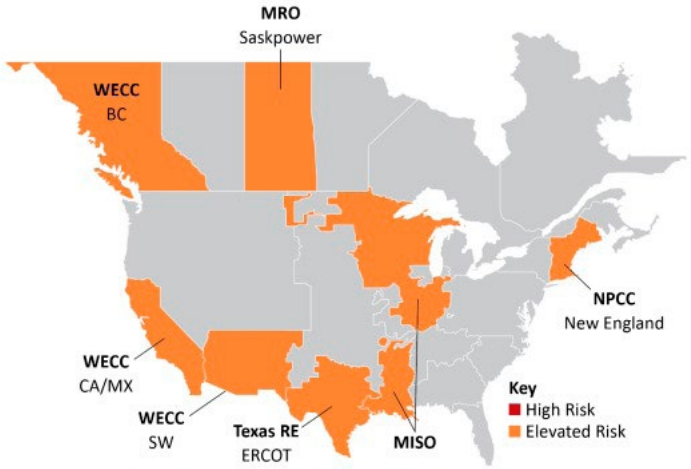


Figure 1: Summer Reliability Risk Area Summary

Seasonal Risk Assessment Summary	
High	Potential for insufficient operating reserves in normal peak conditions
Elevated	Potential for insufficient operating reserves in above-normal conditions
Normal	Sufficient operating reserves expected

MIDWEST RELIABILITY ORGANIZATION (MRO)

The MRO operates as a cross-border Regional Entity headquartered in Saint Paul, Minnesota. The MRO region spans the provinces of Saskatchewan and Manitoba, and all or parts of the states of Arkansas, Illinois, Iowa, Kansas, Louisiana, Michigan, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, and Wisconsin. The region includes approximately 225 organizations that are involved in the production and delivery of electric power, including municipal utilities, cooperatives, investor-owned utilities, transmission system operators, federal power marketing agencies, Canadian Crown Corporations, and independent power producers.

MRO's primary responsibilities are to: ensure compliance with mandatory reliability standards by entities who use, own, or operate the North American bulk power system; conduct assessments of the grid's ability to meet electric power demand in the region; and analyze regional system events. Additionally, MRO creates an open forum for stakeholder experts in the region to discuss important topics related to addressing risk and improving reliable operations of the grid. MRO serves as a vital link between grid owners, users, operators, and other stakeholders who share common reliability interests in the region.

The North Dakota Transmission Authority became a member of this organization for the first time in November 2023. The NDTA Executive Director participates in the "adjunct sector" of the organization. North Dakota transmission utilities are participants and members of the organization. The MRO provides a valuable forum to discuss grid reliability and generation resource adequacy risks.

ND GRID RESILIENCY REPORT

The NDTA supports the development of the ND Grid Resiliency Plan, a section in the North Dakota State Energy Security and Resiliency Plan. The report is updated annually with help from the EERC staff. Threats to North Dakota's electric grid include extreme weather events, changing generation fuel mix, resource adequacy, supply chain interruptions, aging infrastructure, and physical/cyber-attacks. This report provides information that will help communities ensure that the electric grid infrastructure is more resilient when catastrophic events occur. North Dakota utilities have a long history of expeditious and safe system restorations following floods, winds and ice storms. The 2023 December Ice Storm manifested the collaborative spirit among investor-owned utilities and cooperatives working to safely restore vital electric service to North Dakotans.

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DISCLAIMER

This report utilizes data from various sources. Those sources are appreciated for their willingness and availability. If users of this report utilize that information, please go to the source to assure the most accurate and up to date information.

Thanks for the Energy Information Administration (EIA), Southwest Power Pool (SPP), Midcontinent Independent System Operator (MISO), area utilities and WIND and their members especially.