Ensuring Energy Deliverability Through the Grid of Tomorrow

Mark Lauby and Richard Burt
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Strong Regions + Strong NERC = Brilliant ERO

Mark Lauby

NERC Senior Vice President and Chief Engineer

Mr. Lauby joined NERC in January 2007 and has held a number of positions, including vice president and director of Standards and vice president and director of Reliability Assessments and Performance Analysis.

In 2012, Mr. Lauby was elected to the North American Energy Standards Board and was appointed to the Department of Energy’s Electric Advisory Committee by the Secretary of Energy from 2013-2017. He has been recognized for his achievements including the 1992 IEEE Walter Fee Young Engineer of the Year Award. He was named a Fellow by IEEE in November 2011 for “leadership in the development and application of techniques for bulk power system reliability,” and in 2014, Mr. Lauby was awarded the IEEE Power and Energy Society’s Roy Billinton Power System Reliability Award. In 2020, the National Academy of Engineering (NAE) elected Mr. Lauby as a member.

Prior to joining NERC, Mr. Lauby worked for the Electric Power Research Institute (EPRI) for 20 years.

Mr. Lauby began his electric industry career in 1979 at the Mid-Continent Area Power Pool in Minneapolis, Minnesota. Mr. Lauby is the author of more than 100 technical papers. He earned his bachelor’s and master’s degrees in Electrical Engineering from the University of Minnesota. In addition, Mr. Lauby attended the London Business School Accelerated Development Program, as well as the Executive Leadership Program at Harvard Business School.

Richard Burt

MRO Senior Vice President and Chief Operating Officer (COO)

As chief operating officer, Richard Burt leads the organization's industry-facing efforts with regard to reliability and security initiatives that strengthen the bulk power system in MRO's regional footprint. As an engineer with technical experience in telecommunications, transmission planning studies, control systems, power quality, and security, Burt acts as liaison to the board's Organizational Group Oversight Committee (OGOC). The OGOC is tasked with implementing the board's vision of a stakeholder structure that effectively and efficiently supports MRO's mission 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).

Burt joined MRO in February 2012 as principal risk assessment and mitigation engineer and was soon after promoted to vice president risk assessment and mitigation and standards in April 2015. In August 2018, he was named senior vice president and chief operating officer.

He brings a diverse technical power systems background to MRO's leadership team obtained through 14 years of industry experience. Burt earned his Bachelor of Science degree in Electrical Engineering from the University of North Dakota, and has also completed the University of Idaho Utility Executive Course. He is a Senior Member of the Institute of Electrical and Electronics Engineers (IEEE) and the IEEE Power and Energy Society.

- The following drivers have led to rapid changes in energy resources:
  - Governmental policies
  - Changes in resource economics
  - Consumer demand for clean energy
- In addition to the shift in resources, an increase in extreme weather presents new challenges
  - Fuel sources are inherently less secure

Four Pillars of the Energy Transition

No/Low Carbon Energy Resources

Ensure sufficient amounts of no/low carbon energy to achieve decarbonization goals

Transmission

Develop adequate transmission to integrate renewables and transmit/distribute energy

Balancing Resources

Maintain a robust fleet of balancing resources needed to serve energy along with integrated renewables

Energy Supply Chain

Ensure healthy energy supply chains for balancing resources, with sufficient access to stored energy to withstand long-duration, widespread extreme weather events

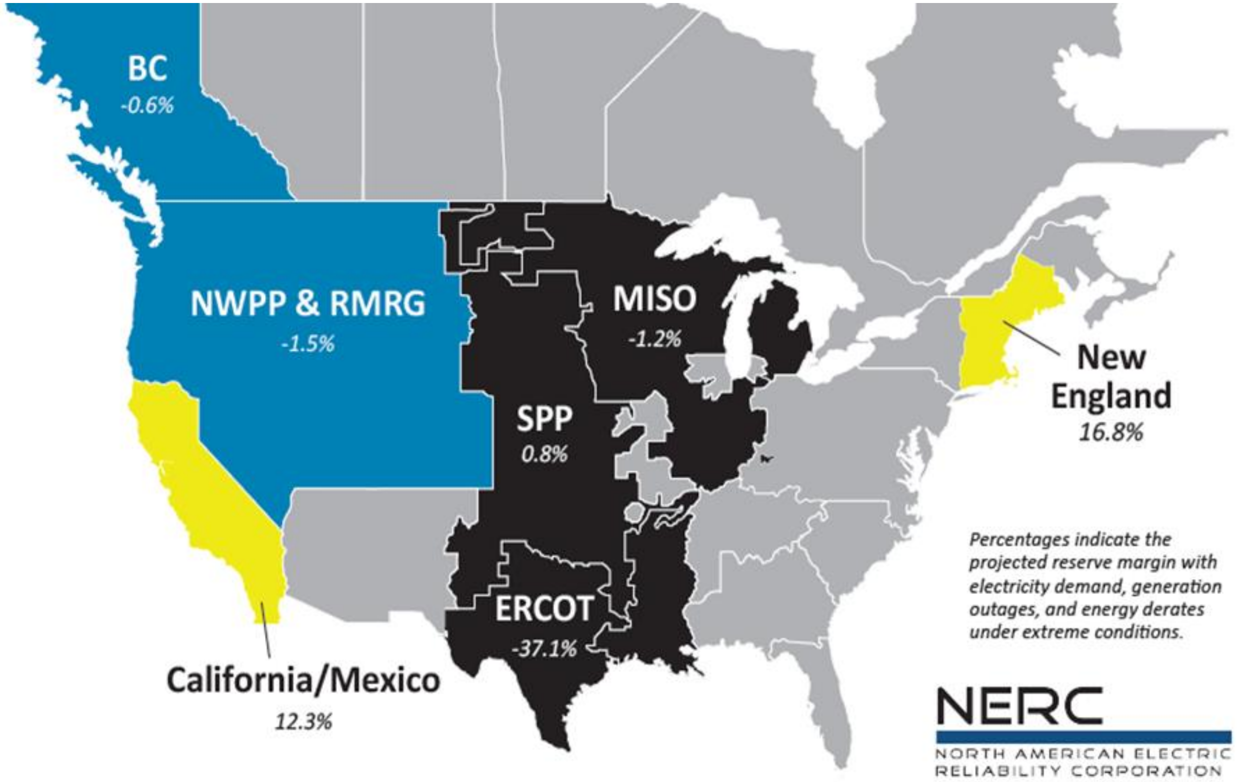
The Challenge: Sufficient Energy Availability

- Power grid transition is resulting in a higher level of energy uncertainty, regardless of fuel type
  - The current tools, rules of thumb, and approaches used to determine the system’s ability to meet demand were not designed for today’s grid

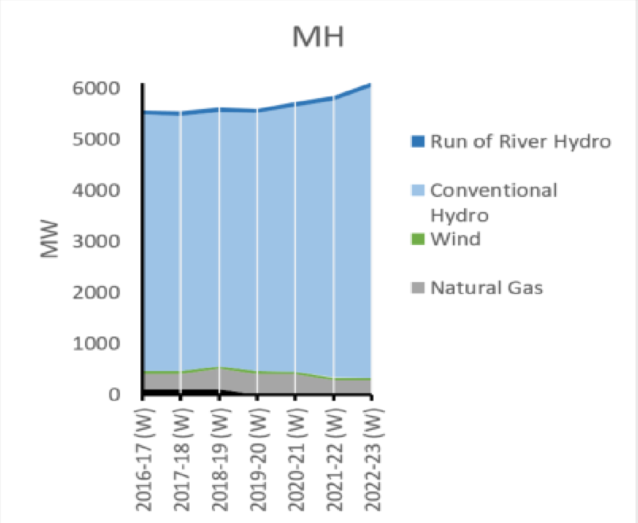
- **The focus needs not be on fuel type, but rather on energy availability**

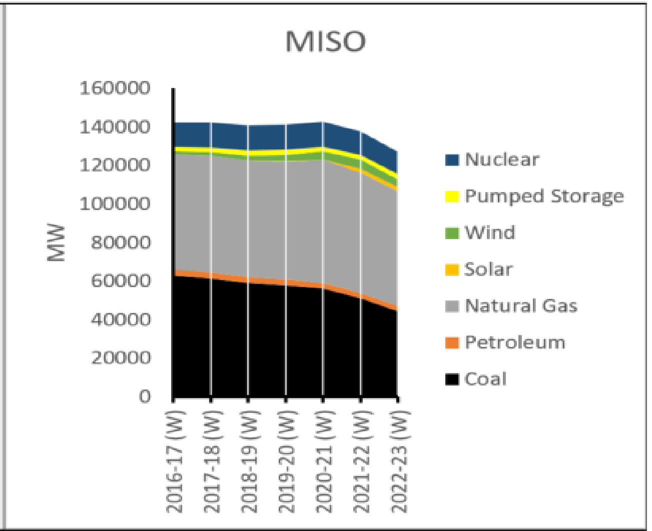
- Rapidly changing generation fleet
- Increasing electrification
- Widespread, long-duration, extreme weather events
- Historically, industry ensured energy through capacity and reserve margins with assurance of fuel

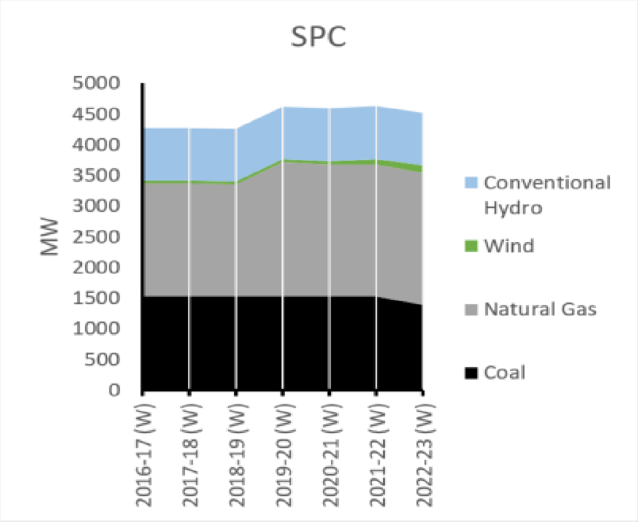
Forecasted 2021/2022 Winter PRMs	
MISO	SPP
49%	56%

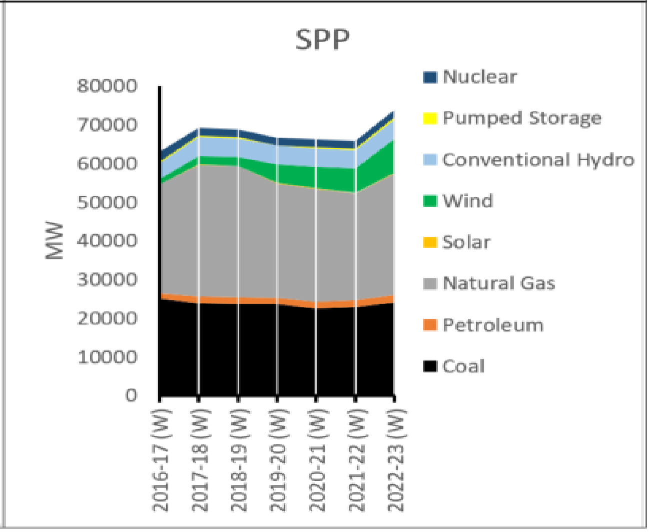


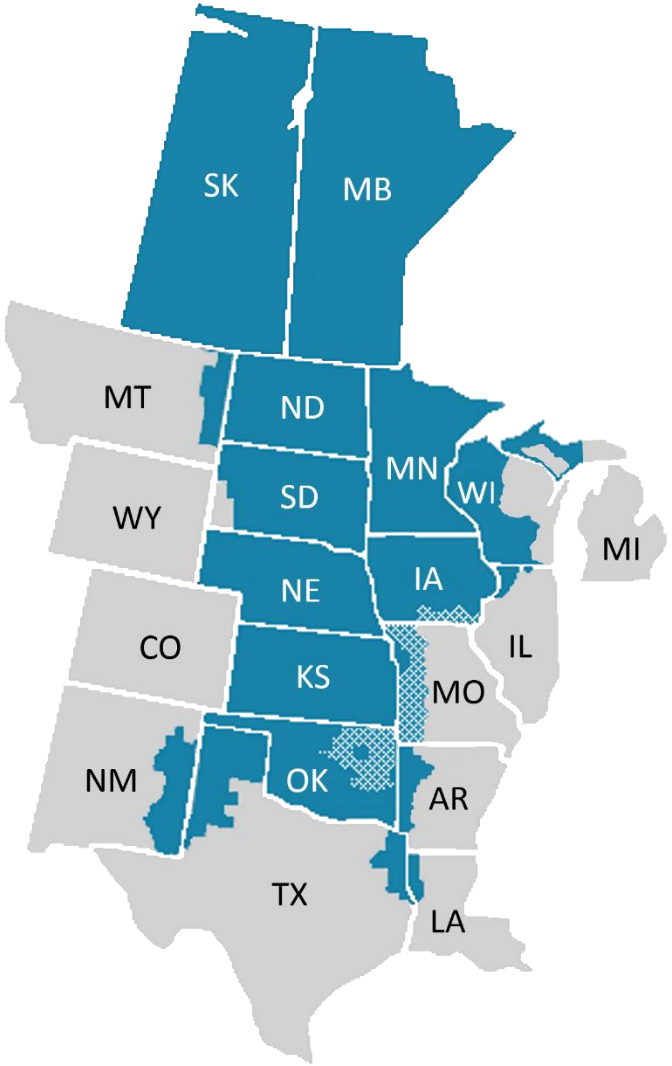
Regional Generation Changes



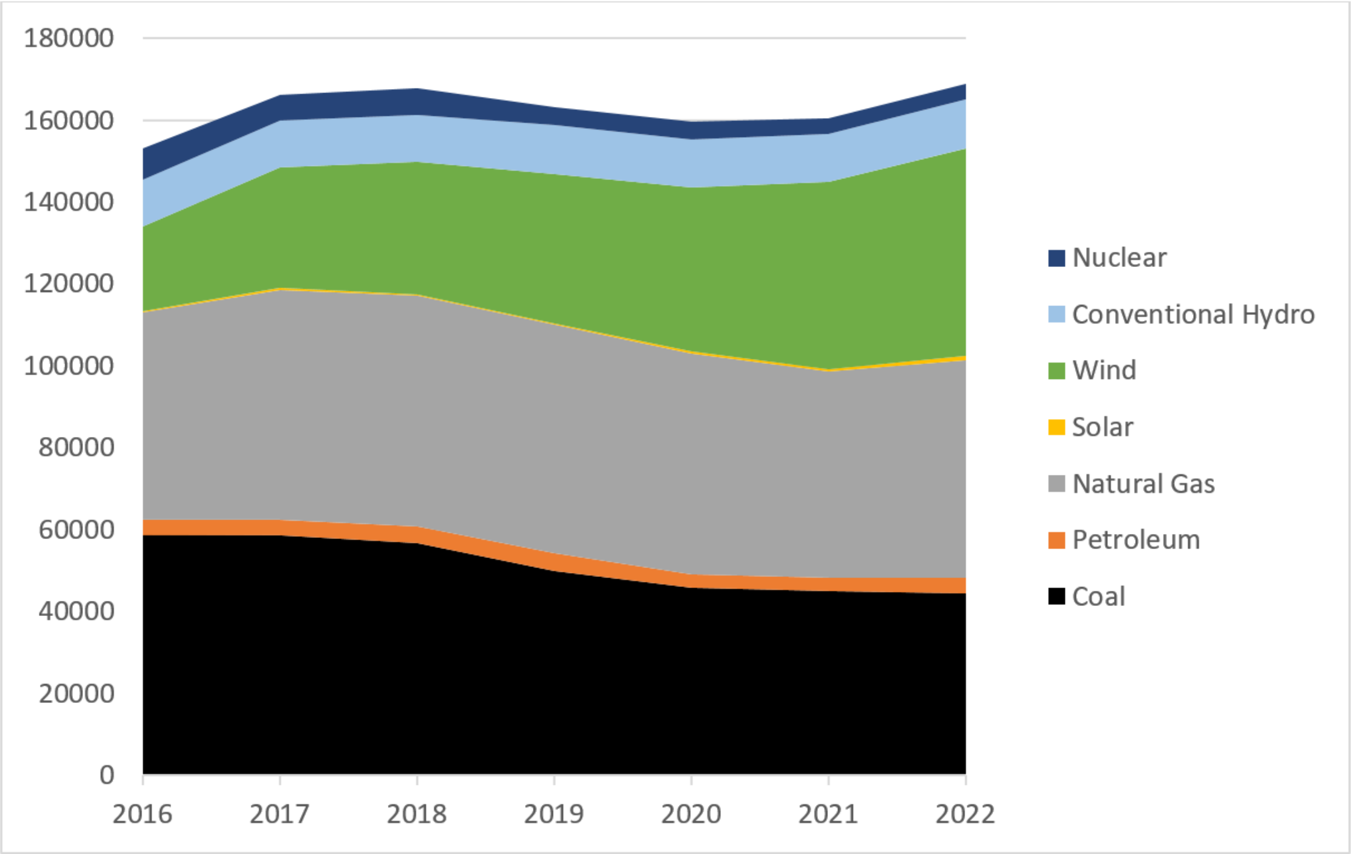




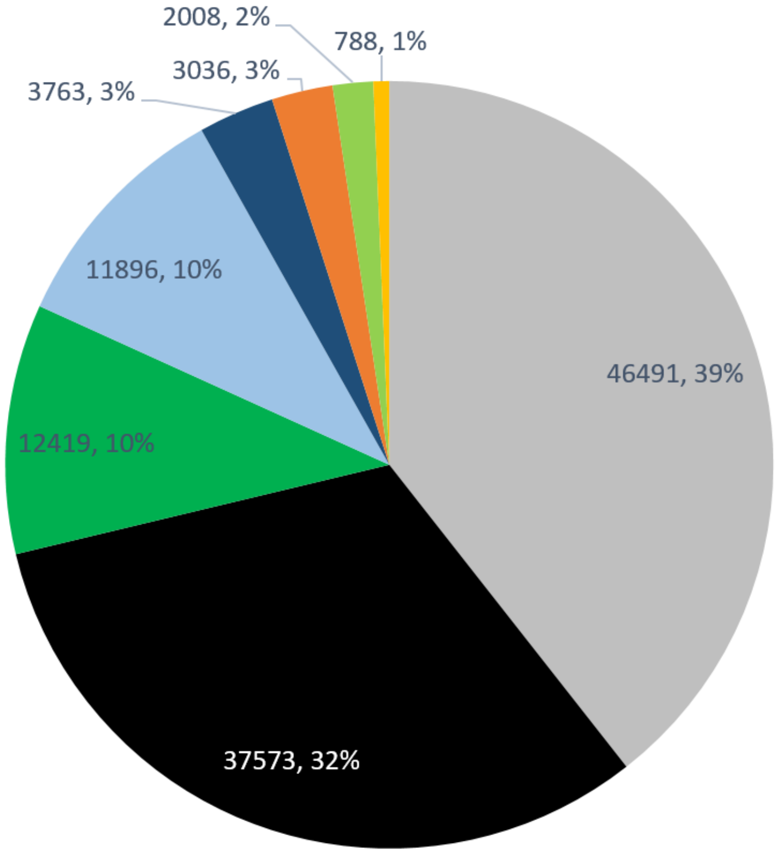




MRO Nameplate vs. Capacity



Nameplate



Capacity

ERO Capacity vs. Load

Table 3.2: Generation Resource Capacity by Fuel Type

Generation Fuel Type	2011 On-Peak		2021 On-Peak	
	GW	Percent	GW	Percent
Coal	318.5	30.5%	219.8	21.4%
Natural Gas	385.9	36.9%	462.9	45.0%
Hydro	153.9	14.7%	132.6	12.9%
Nuclear	111.6	10.7%	107.7	10.5%
Oil	50.3	4.8%	39.6	3.8%
Wind	13.7	1.3%	25.4	2.5%
Solar PV	0.5	0.1%	25.7	2.5%
Other	10.0	1.0%	15.0	1.5%
Total:	**1,044.5**	**100.0%**	**1,028.7**	**100.0%**

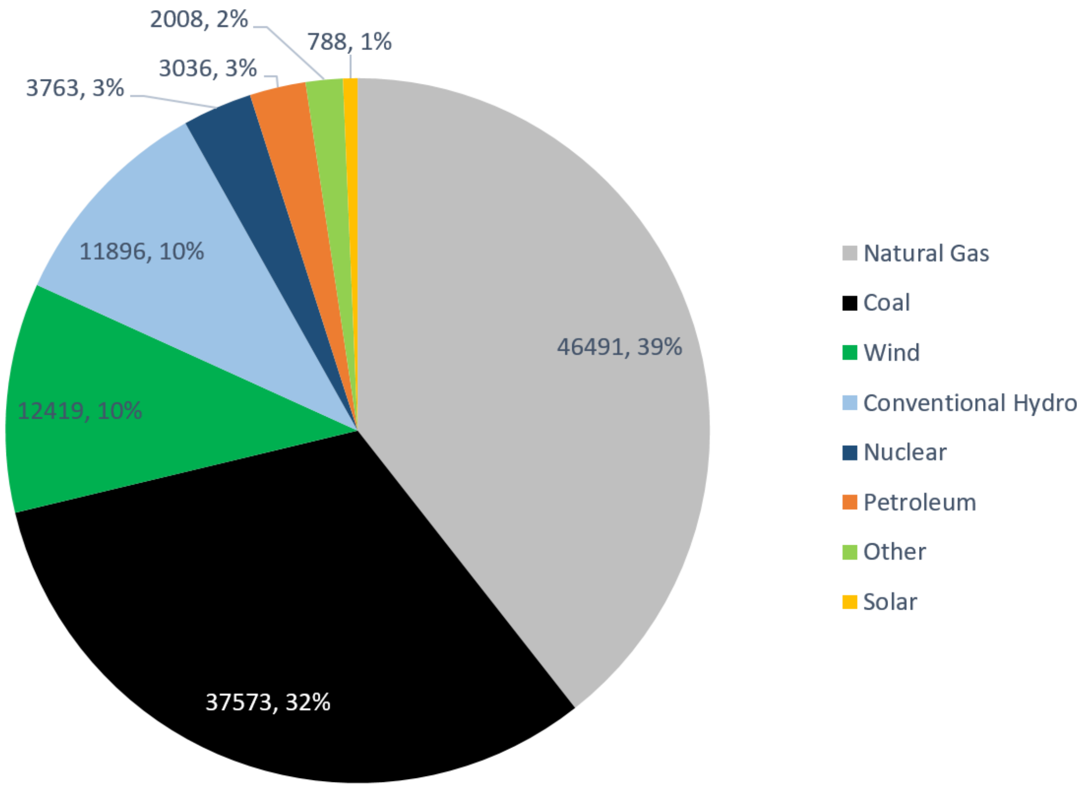
Installed wind nameplate = 138 GW in 2021, yet accredited wind capacity at peak load is 25.4 GW (or 2.5% of total resource capacity).

Total capacity has dropped by 16 GW from 2011 to 2021, however total load has increased by about 85 GW in the same 10 years.

Across North America, from 2011-2021:

- Load has grown 85 GW while CAPACITY has dropped by 16 GW
- 2021 Wind Capacity was 2.5% of total (10% in wind-heavy MRO)

Area	2021-22 Winter Nameplate (MW)	2022-23 Winter Nameplate (MW)	2022-23 Winter Peak Capacity (MW)
MH	259	259	52
MISO (MRO)	28,447	28,893	4,478
SPC	628	628	88
SPP	27,535	31,325	8,918



Influx of Solar is Coming to MRO

Solar and Wind Nameplate Capacity, Existing and Planned Additions through 2031										
Assessment Area	Nameplate MW of Solar					Nameplate MW of Wind				
	Existing	Tier 1	Tier 2	Tier 3	Total	Existing	Tier 1	Tier 2	Tier 3	Total
MISO	728	10,989	53,756	4,907	**70,380**	22,854	5,593	14,649	730	**43,826**
MH	0	0	0	0	**0**	259	0	0	0	**259**
SPC	2	10	10	57	**79**	242	385	200	100	**927**
SPP	278	444	32,170	149	**33,041**	27,535	4,604	16,892	0	**49,031**
Total	1,008	11,443	85,936	5,113	**103,500**	50,890	10,582	31,741	830	**94,043**

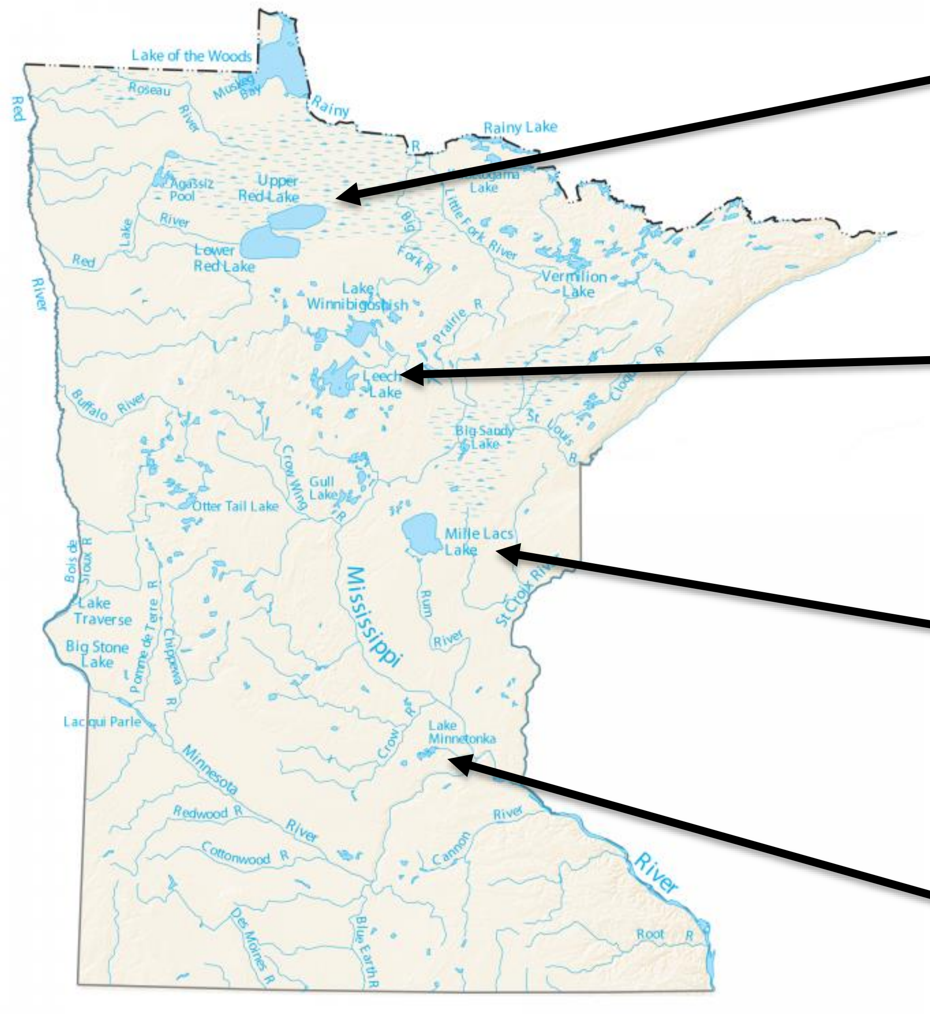
Existing Solar
1,008 MW

Existing Wind
50,890 MW

Queued Solar: 102,492 MW

Future Wind: 43,153

Footprint of Queued Solar



3.5 x Red Lake: 288,000 acres

9 x Leech: 111,000 acres

8 x Mille Lacs: 128,000 acres

71 x Minnetonka: 14,000 acres

Energy Availability in 3 Timeframes

Mid-to-Long Term

(1-5 years)

- Ensure that resources are planned that can provide options to obtain sufficient and flexible energy resources
- Review tools, rules-of-thumb and processes to support the need for these energy resources

Operational Planning

(1 day – 1 year)

- Ensure sufficient resources are available and able to provide energy to meet demand and off-set ramping requirements
- Electrical energy production needs to reflect status of energy availability given the uncertainties

Real-Time

(0-1 day)

- Ensure sufficient amounts of capacity, energy, and ramp flexibility are available from available resources

What MUST Be Done?

Define Energy Availability Studies

Require Energy Availability Studies

Take action for all time horizons

Energy Availability

Electric Reliability Organization: Reliability Risk Mitigation Toolkit

Reliability Guideline

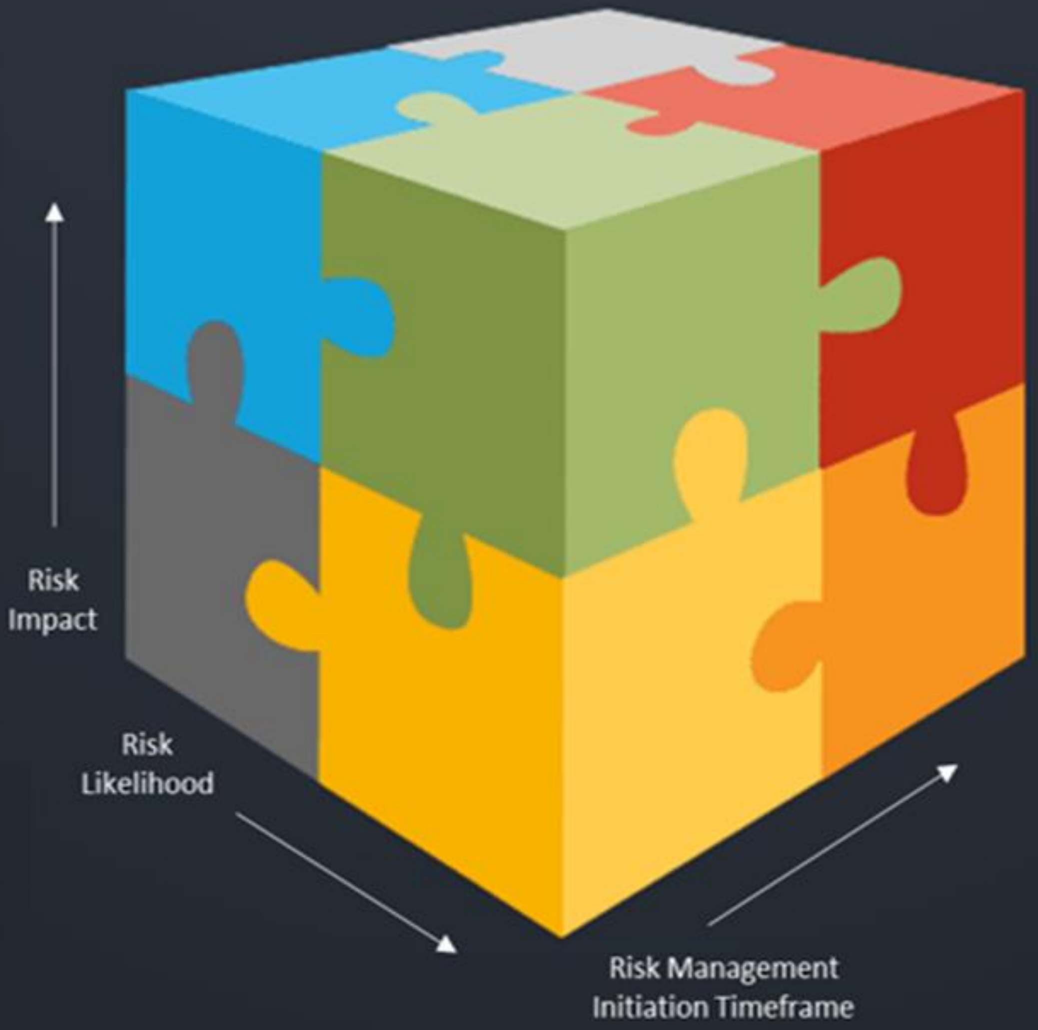
Suggested approaches or behavior in a given technical area for the purpose of improving reliability. Guidelines are not enforceable, but may be adopted by a responsible entity in accordance with its own policies, practices, and conditions.

NERC Alert: Level 2-3

NERC alerts are divided into three distinct levels, 1) Industry Advisory, 2) Recommendation to Industry, and 3) Essential Action, which identifies actions to be taken and require the industry to respond to the ERO.

Technical Engagement

Technical Engagement is a catch-all for a variety of technical activity that is conducted between the ERO and entities. This includes, technical committee activities, technical reference documents, workshops and conferences, assist visits, joint and special studies, etc.



Reliability Standards

NERC Reliability Standards define the mandatory reliability requirements for planning and operating the North American BPS and are developed using a results-based approach focusing on performance, risk management, and entity capabilities.

Reliability Assessment

NERC independently assesses and reports on the overall reliability, adequacy, and associated risks that could impact BPS reliability. Long-term assessments identify emerging reliability issues that support public policy input, improved planning and operations, and general public awareness.

NERC Alert: Level 1

NERC Alerts are divided into three distinct levels, 1) Industry Advisory, 2) Recommendation to Industry, and 3) Essential Action, which identifies actions to be taken and require the industry to respond to the ERO.

Partners to Get Us There

U.S. DEPARTMENT OF ENERGY

Electric Industry

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Energy Planning

- *Metric and Scenario Development*
- *Climatology Data*
- *Fuel Assessment*
- *Power System Research*

Energy Assessment

- *Metric Evaluation*
- *Probabilistic Energy Analysis*
- *Criteria Determination*

Regulatory and Policy

- *Independent Assessment*
- *Reliability Standards*
- *Power Supply Authority*

NOAA

EPRI

NATURAL GAS COUNCIL
Five Associations, One Mission: Natural Gas

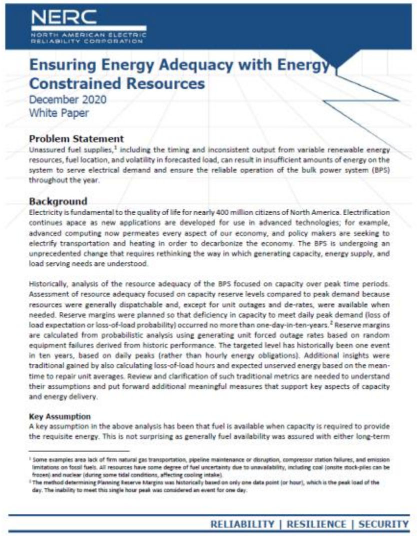
NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Reliability &Security Technical Committee	Reliability Issues Steering Committee

National Association of Regulatory Utility Commissioners

Energy Reliability Assessments Task Force (ERATF)

Utilities	ISOs/RTOs	EPRI	Manufacturers	ERO



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Ensuring Energy Adequacy with Energy Constrained Resources

December 2020
White Paper

Problem Statement

Unassured fuel supplies,[1] including the timing and inconsistent output from variable renewable energy resources, fuel location, and volatility in forecasted load, can result in insufficient amounts of energy on the system to serve electrical demand and ensure the reliable operation of the bulk power system (BPS) throughout the year.

Background

Electricity is fundamental to the quality of life for nearly 400 million citizens of North America. Electrification continues apace as new applications are developed for use in advanced technologies; for example, advanced computing now permeates every aspect of our economy, and policy makers are seeking to electrify transportation and heating in order to decarbonize the economy. The BPS is undergoing an unprecedented change that requires rethinking the way in which generating capacity, energy supply, and load serving needs are understood.

Historically, analysis of the resource adequacy of the BPS focused on capacity over peak time periods. Assessment of resource adequacy focused on capacity reserve levels compared to peak demand because resources were generally dispatchable and, except for unit outages and de-rates, were available when needed. Reserve margins were planned so that deficiency in capacity to meet daily peak demand (loss of load expectation or loss-of-load probability) occurred no more than one-day-in-ten-years.[2] Reserve margins are calculated from probabilistic analysis using generating unit forced outage rates based on random equipment failures derived from historic performance. The targeted level has historically been one event in ten years, based on daily peaks (rather than hourly energy obligations). Additional insights were traditional gained by also calculating loss-of-load hours and expected unserved energy based on the mean-time to repair unit averages. Review and clarification of such traditional metrics are needed to understand their assumptions and put forward additional meaningful measures that support key aspects of capacity and energy delivery.

Key Assumption

A key assumption in the above analysis has been that fuel is available when capacity is required to provide the requisite energy. This is not surprising as generally fuel availability was assured with either long-term

[1] Some examples area lack of firm natural gas transportation, pipeline maintenance or disruption, compressor station failures, and emission limitations on fossil fuels. All resources have some degree of fuel uncertainty due to unavailability, including coal (onsite stock-piles can be frozen) and nuclear (during some tidal conditions, affecting cooling intake).

[2] The method determining Planning Reserve Margins was historically based on only one data point (or hour), which is the peak load of the day. The inability to meet this single hour peak was considered an event for one day.

RELIABILITY | RESILIENCE | SECURITY

Industry Input Received

- What do we do with high impact, low likelihood energy assessments?
- Energy assessments need to be performed throughout the year, not just for peak cases
- Geographical nuances to reliability issues related to energy availability
- Dependency on other critical infrastructure is a key aspect of this risk, and there is a likely need to model fuel infrastructure
- Need to create metrics and criteria for energy assessments
- Assumptions used in studies must be a focus, and various scenarios considered including extreme events
- Assessments need to be considered in the operational timeframe as well, not just long-term planning

- Industry workshop held to discuss feedback and survey results
- Reviewed current NERC Standards against this risk
    - Determined need for new Standards related to both real-time operations and planning

- May 2022 – Review industry comments and proposed responses at NERC MRC (Members Representative Committee)
- May 2022 – Hold an outreach conference on the proposed responses to industry comments and update the SAR (Standard Authorization Request)
- June 2022 – NERC RSTC (Reliability and Security Technical Committee) SAR endorsement
- June 2022 – NERC Standards Committee SAR acceptance
- July 2022 – Industry Comment Period for SARs
- September 2022 – Drafting Team Appointed

Questions and Answers