

Agenda

NERC Quarterly Technical Session

August 13, 2025 | 1:30 – 4:00 p.m. Mountain

In-Person

The Westin Calgary Downtown
320 4th Avenue SW
Calgary, Alberta, Canada B T2P 2S6

Conference Room: Britannia/Belaire/Mayfair Ballroom – Conference Level

Virtual Attendees

Webcast Link: [Join Meeting](#)

Webcast Password: Day1Aug25ATT (32912843 from phones)

Audio Only: 1-415-655-0002 US | 1-416-915-8942 Canada | Access Code: 2304 717 8300

[NERC Antitrust Compliance Guidelines](#)

Agenda Items

1. Panel Session on Large Load Integration* – Update

- a. Large Loads Action Plan: Addressing Reliability Impacts from Large Load Integration, *Mark Lauby*
- b. Large Loads Task Force Update, *Rich Hydzik, Latrice Harkness*
- c. Large Loads Industry Perspective Panelists:
 - i. Chris Matos, Energy Market Development Strategic Negotiator at Google
 - ii. Goran Arya, Senior Manager, Global Renewable Energy at Equinix
 - iii. Nate Hill, Principal, Energy Policy at Amazon Web Services (AWS)
- d. Facilitated Discussion, *Mark Lauby*

Break

2. Panel Session on Gas-Electric Coordination* – Update

- a. Canadian Perspective: Mike Johnson, Technical Leader on the Energy Supply and Data Team at the Canada Energy Regulator (CER)
- b. Prioritizing Gas-Electric Interdependency Risks and Mitigation Efforts, *John Moura*
- c. Natural Gas Industry Perspective Panelists:
 - i. Chris Smith, Regulatory Counsel for the Interstate Natural Gas Association of America (INGAA)

- ii.* Jesse Sandlin, Director of Policy and Regulatory Affairs at American Exploration & Production Council (AXPC)
- iii.* Matt Agen, Chief Regulatory Counsel, Energy at American Gas Associations (AGA)
- d. Facilitated Discussion, *Camilo Serna*

3. Closing Remarks and Conclude Session

Appendix and Informational Items Included in Package

- Appendix Item 1 – NERC Electric/Gas Efforts Updated
- Appendix Item 2 – Electricity-Natural Gas Strategy Paper
- Informational Item – BPSA Update

*Background materials included.

Panel Session on Large Load Integration

Action

Update

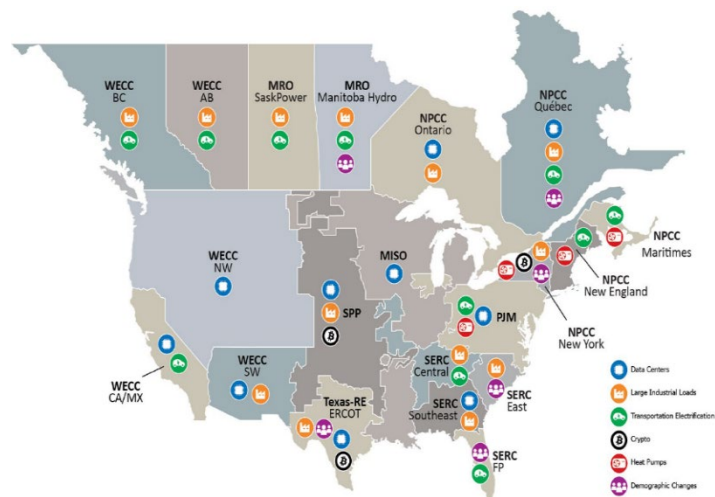
Session Overview

The panel session will focus on the ongoing work and progress toward assessing large load integration risks and their mitigation. It will include:

- An overview of considerations and experience with large load integration, the incidents NERC analyzed in Virginia, and the NERC Large Loads Action Plan presented by Mark Lauby, Senior Vice President and Chief Engineer, NERC.
- A Large Loads Task Force (LLTF) update and overview of next steps presented by Rich Hydzik, Chair of the Reliability and Security Technical Committee (RSTC), and Latrice Harkness, NERC's Director of Engineering.
- Remarks from data center representatives, including Nate Hill from Amazon, Chris Matos from Google, and Goran Arya from Equinix.
- Open discussion with Board and Members Representative Committee (MRC).

Background

Increasing amounts of large commercial and industrial loads are connecting rapidly to the bulk power system (BPS). Serving this demand is vital for the Nation's economy. Yet, it is critical that these loads are integrated in a way that ensures the reliable operation of the BPS, rather than reducing the grid's performance. In doing so, more demand can be served, assuming that energy production is available or can be built in time to serve consumers.



For instance, recent off-nominal occurrences in [Virginia](#) have illustrated a current challenge of large electric loads. After the grid experienced a fault, large amounts of demand left the system by engaging their uninterruptible power supply plans. This sudden reduction of demand exacerbated the impacts of this system fault on the BPS.

Emerging large loads (e.g., data centers (including crypto and AI), hydrogen fuel plants, etc.) present unique challenges to forecast and plan for increased demand (See Figure above from [2024 Long-term Reliability Assessment](#)). To begin understanding large loads and the best ways to support their integration, NERC's Reliability and Security Technical Committee (RSTC) established in August 2024 a Large Loads Task Force (LLTF), which has a defined [Scope](#) and [Work Plan](#). At NERC's February 2025 Board of Trustees (Board) Meeting, the Board gathered additional information to better understand the reliability considerations around large loads integration by

having the Member Representatives Committee provide [written input](#), and by hosting a [technical session panel](#). The Board resolved that NERC staff should come forward at their May 2025 meeting with an Action Plan to address integration of large loads, leveraging the results of the LLTF. NERC briefly introduced the Large Loads Action Plan at the May 8, 2025, technical session.

Action Plan

The Action Plan consists of three main efforts, one of which is the LLTF and the ongoing advancement of its Work Plan. In addition, there are several complementary activities that support these efforts and build a more solid foundation for ongoing efforts at NERC related to large loads integration.

Large Loads Task Force (LLTF)

Based on its current Work Plan, the LLTF will publish three deliverables:

- A white paper on “Characteristics and Risks from Emerging Large Loads,” which was released in July 2025
- A white paper on “Assessment of Gaps in Existing Practices, Requirements, and Reliability Standards for Emerging Large Loads,” which is in progress and expected to be released in late 2025
- A Reliability Guideline on Risk Mitigation for Emerging Large Loads that is in progress and expected to be released in Q2 2026.

These deliverables will focus primarily on data centers, including Artificial Intelligence (AI) and Crypto-Currency mining. Though it is important to still consider hydrogen fuel plants and other large loads that may present challenges, their integration has not had the acceleration or the magnitude observed in the data center industry. Additionally, they share significant commonalities with data center loads.

NERC-led Collaborative Industry Sessions

This plan recommends a coordinated series of collaborative, cooperative, and transparent events focused on building a reliability community between targeted large load and BPS owners, users, and operators. The pace of these meetings should accommodate and support the LLTF deliverables. Additionally, there should be distinct sessions that presents opportunities for collaboration among industry leadership and industry technical staff, respectively.

NERC will design these meetings based on the desired outcomes (e.g., it may host a workshop or develop a multi-panel conference). The LLTF will enhance its roster with additional members, if needed, to ensure sufficient representation of all relevant stakeholders.

The LLTF has already hosted two sessions – one in June 2025 and one in July 2025 – to highlight external speakers with valuable perspectives on relevant large loads risks and mitigation opportunities, and to facilitate a dialogue among LLTF members. Potential future sessions could include an industry leadership roundtable and a technical workshop.

Registration Analysis

While the LLTF works to strengthen the community and develop technical background resources, NERC legal should begin preparing the groundwork to support engagement:

- Legal basis for registration of these large users of the bulk power system

- Should Load Serving Entities be held accountable for large load performance, or should large loads be registered directly with NERC.
- NERC's ability to write Reliability Standards that Large Loads or LSEs would be required to follow
- Review of the Procedures and Processes that need enhancement to accommodate LSEs and large loads.

This registration analysis will need to accommodate the ongoing activities with the Board's Modernize Standards Process and Procedures Task Force (MSPP), and NERC's ballot pool review.

Complementary Activities

In addition to these three main efforts, NERC is advancing several complementary activities that support this Action Plan.

- **Load Modeling Working Group (LMWG)** – The Load Modeling Working Group was organized by the RSTC to drive the advancement and use of dynamic load modeling on an interconnection-wide basis. The LMWG will address current issues related to available dynamic load models, develop load model data sets and guidelines for load modeling practices, and provide guidance on future developments of dynamic load modeling capability across North America. Within the deliverables, it is expected that the LMWG will focus on developing modeling tools and guidelines that will help industry better understand the characteristics of these large loads. Also, as part of the Large Loads Action Plan, NERC will ensure that the learnings from the LMWG are reflected in its efforts. Finally, NERC will also consider ways to advance the deliverables without sacrificing quality.

LMWG deliverables are expected to be:

- Assess Refinements to modeling Data Center Loads – Ongoing since Q3 2024
- Develop a Load Modeling Technical Reference – In progress and expected Q2 2026
- **Coordination with Other Efforts** – NERC has and will continue to collaborate and engage in other complementary efforts such as those from Energy Systems Integration Group (ESIG) and ERCOT. As of August 2025, NERC staff are assigned to and actively attending other work groups, and they are determining the best opportunities for coordination and collaboration.
- **Engagement & Outreach** – NERC is focused on expanding its engagement with the Large Loads industry through direct outreach to key trades as well as to large load companies directly. The trade associations are invited to NERC's quarterly Trades & Forum meeting and NERC expects the topic of large loads to be featured recurrently in those meetings. NERC will also seek opportunities to join meetings with members to continue to share the importance of reliability and security to the large load community.
- **Communications Updates** – Several stakeholders recommended considering additional communications tools to keep industry updated on progress. NERC is publishing quarterly updates – with the first update released in July 2025 – and sharing information about its large loads efforts through multiple communications channels.

- **Additional Incident Analysis and Lessons Learned** – NERC and the ERO will continue to monitor large loads integration through its existing situational awareness tools, and event analysis. As new incidents are identified and evaluated, NERC will continue to look for opportunities to provide lessons learned to the industry through incident analysis or other similar tools.

Timeline

NERC expects initial efforts of the LLTF to conclude by the end of Q2 2026. The registration analysis is expected to be completed by the end of 2025. The complementary activities, while tied to the LLTF, may continue beyond Q2 2026 to support future large loads efforts. Following the final LLTF deliverable, and based on LLTF recommendations, NERC will update this Action Plan.

NERC

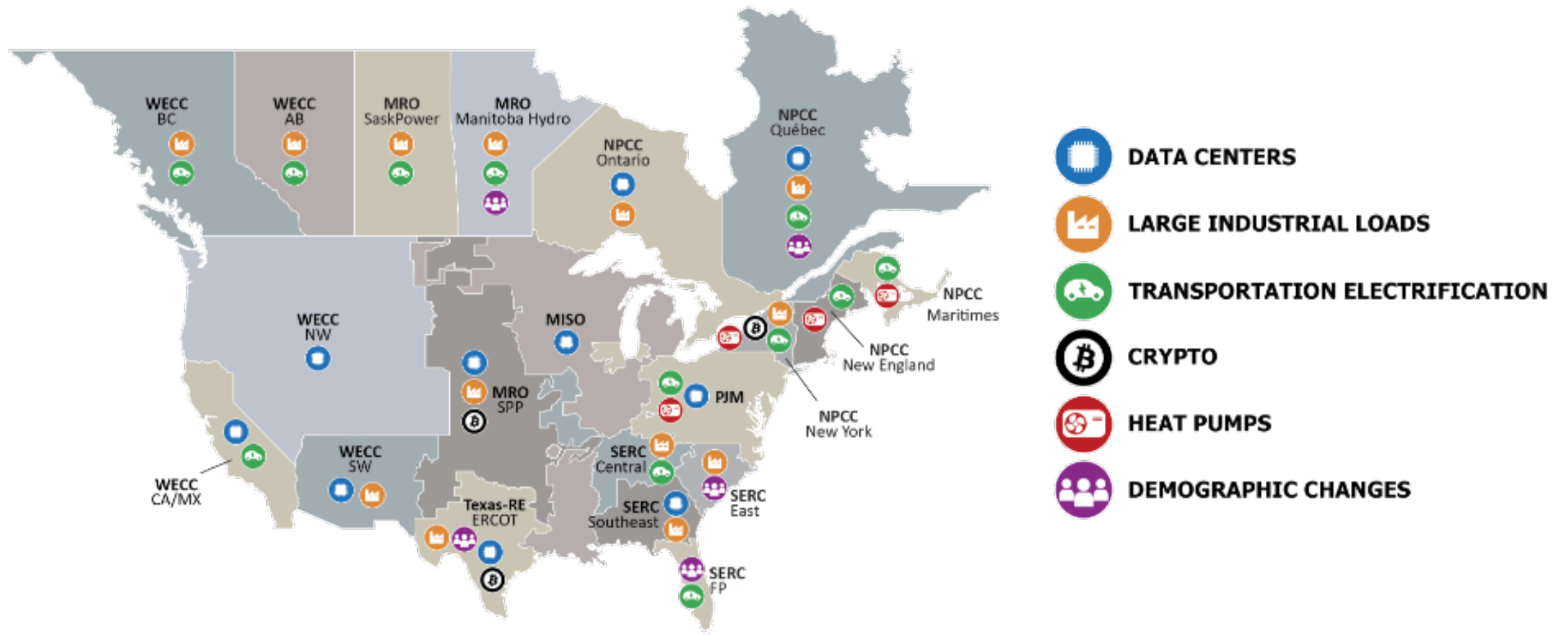
NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

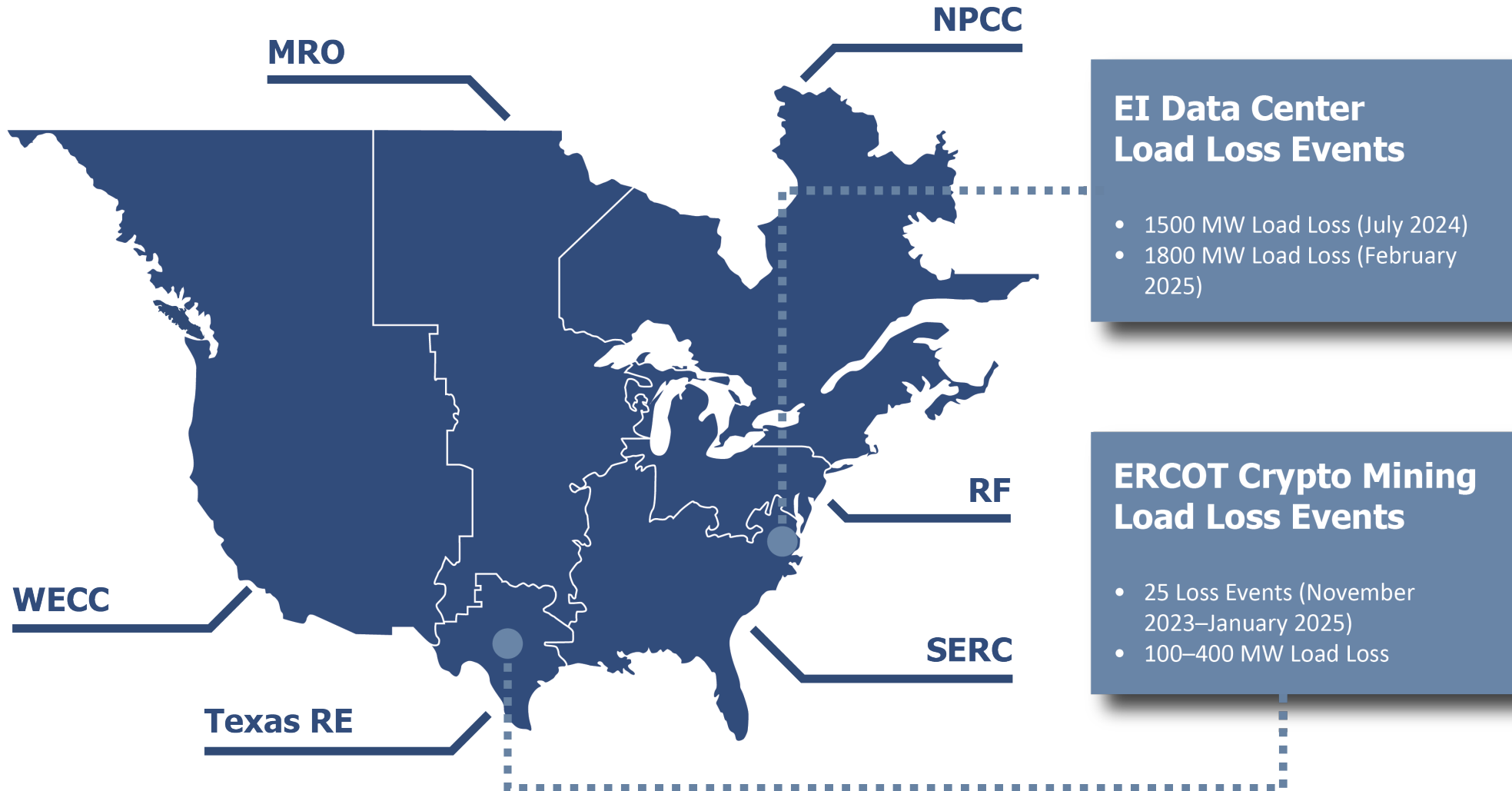
Large Loads Action Plan: Addressing Reliability Impacts from Large Load Integration

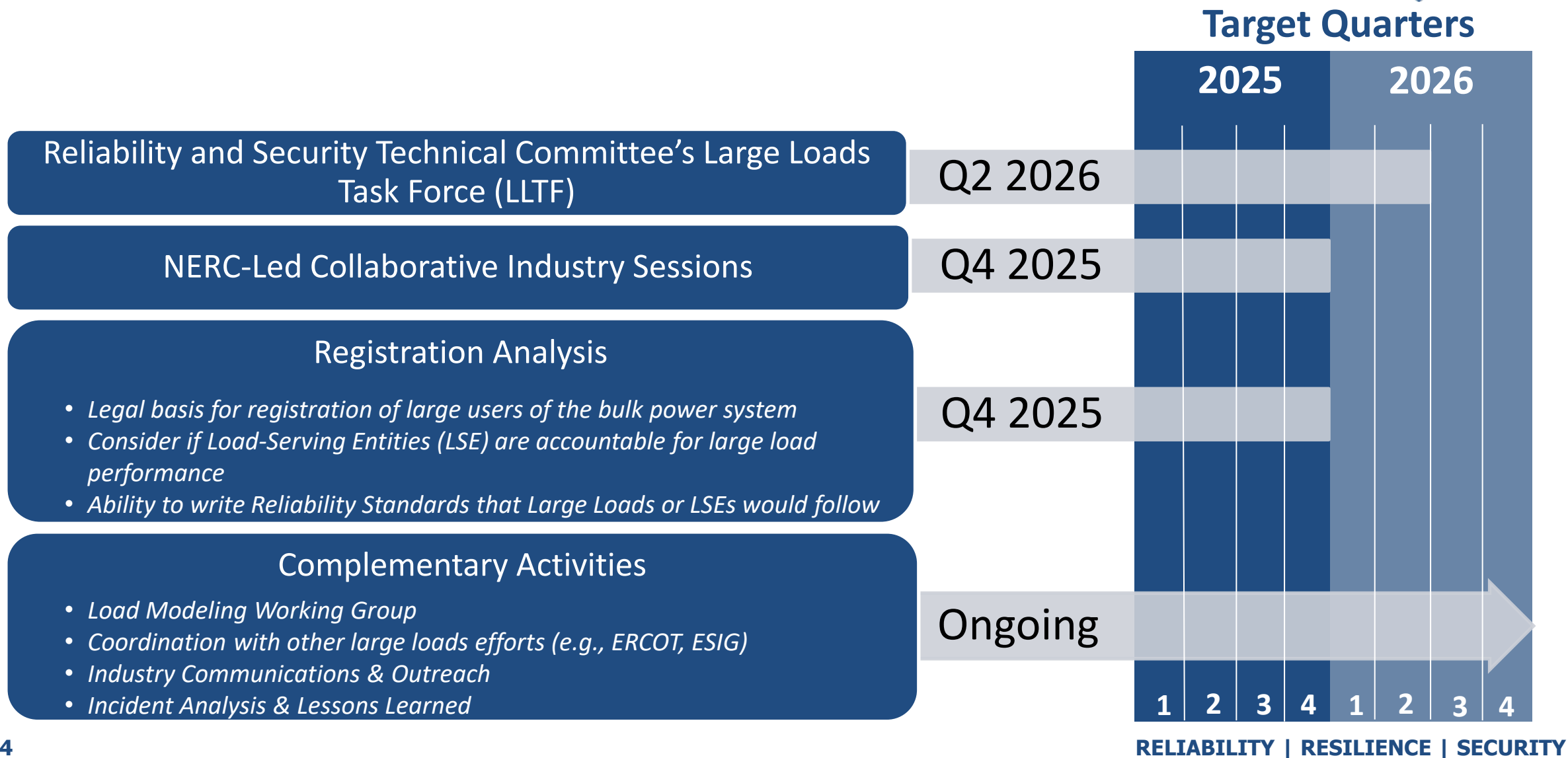
Mark Lauby, Senior Vice President and Chief Engineer
NERC Quarterly Technical Session
August 13, 2025

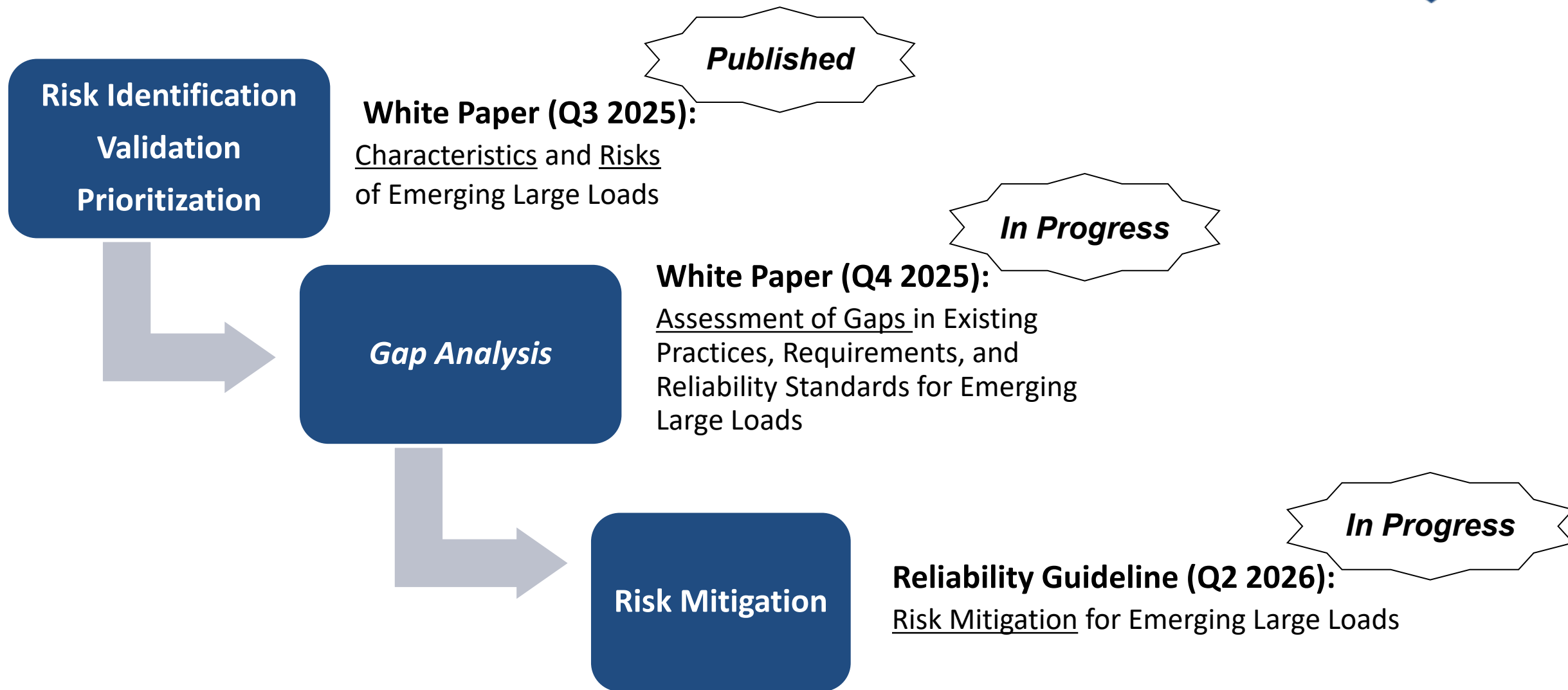
RELIABILITY | RESILIENCE | SECURITY

Primary Demand Drivers by Assessment Area









Completed Industry Sessions



- The LLTF has hosted two “Risk Mitigation Workshops”:
 - **June 2025** - Dominion Energy presented an update on the unplanned data center load transfer events; attendees participated in an extensive Q&A session and provided feedback.
 - **July 2025** – Presentations by Electranix and NERC on mitigating BPS risks related to large load interconnection; attendees participated in an extensive Q&A session and provided feedback.

Potential Future Sessions



- A workshop to address specific technical issues and inform LLTF deliverables.
- A roundtable with industry leadership to share Action Plan results.

Registration Analysis

- Analyze legal basis for registration of large users of the bulk power system - **In progress**

Load Modeling Working Group

- Engaging stakeholders through technical presentations and discussions
- Data Center Technical Reference - **In progress, expected Q2 2026**

Coordination with other Large Loads Efforts

- NERC staff assigned to and actively attending other work groups (e.g., ERCOT)
- Active collaboration underway and developing plans for expanding coordination

Industry Communications & Outreach

- Developed and implementing a strategic engagement and communications plan
- Published first quarterly Large Loads Action Plan update in July 2025
- Actively engaging with the large load entities and key trades & associations

Incident Analysis & Lessons Learned

- Ongoing monitoring, data sharing, and analysis around large loads incidents, specifically those related to voltage disturbances



Questions and Answers

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

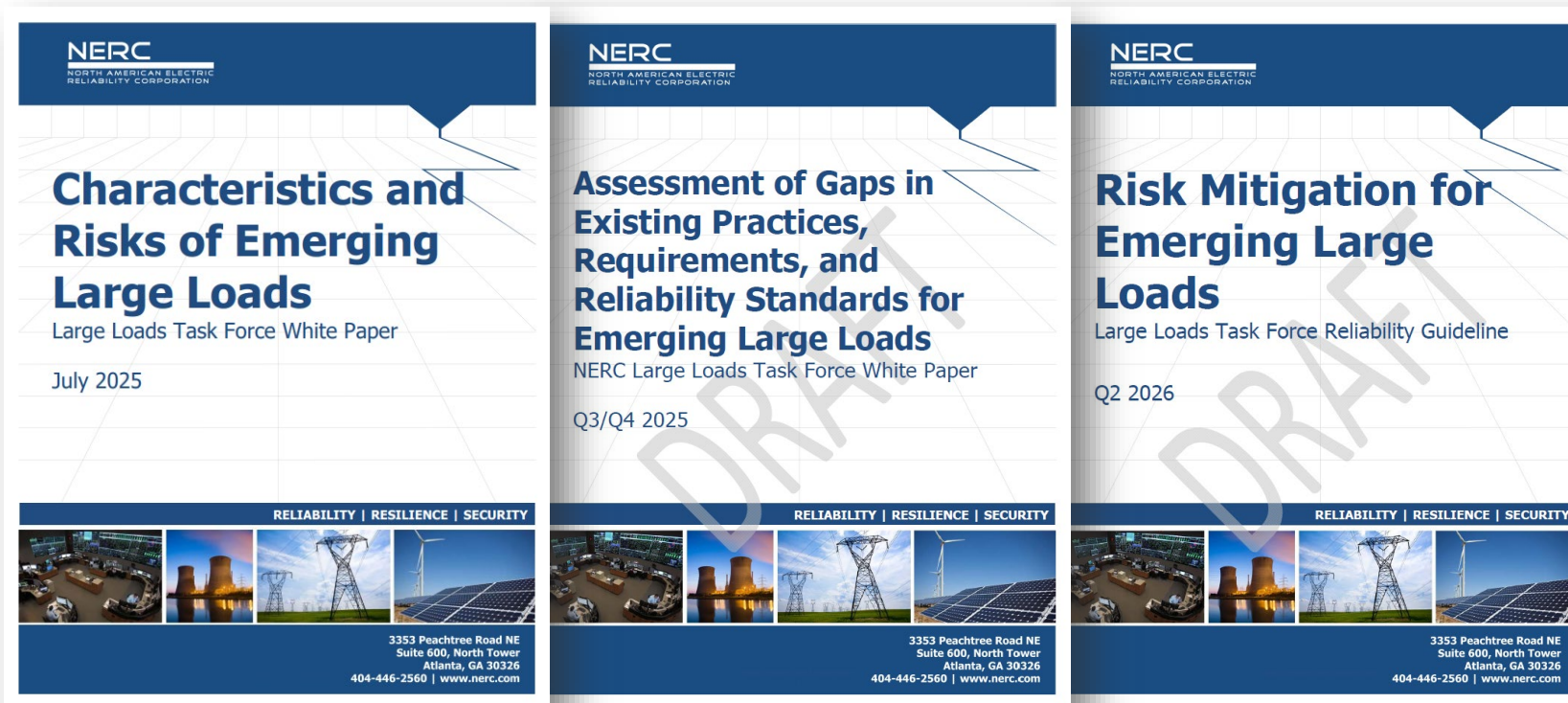
NERC Large Loads Task Force (LLTF) Update

Rich Hydzik – RSTC Chair, Avista Corp
Latrice Harkness – Director of Engineering, NERC
NERC Quarterly Technical Session
August 13, 2025

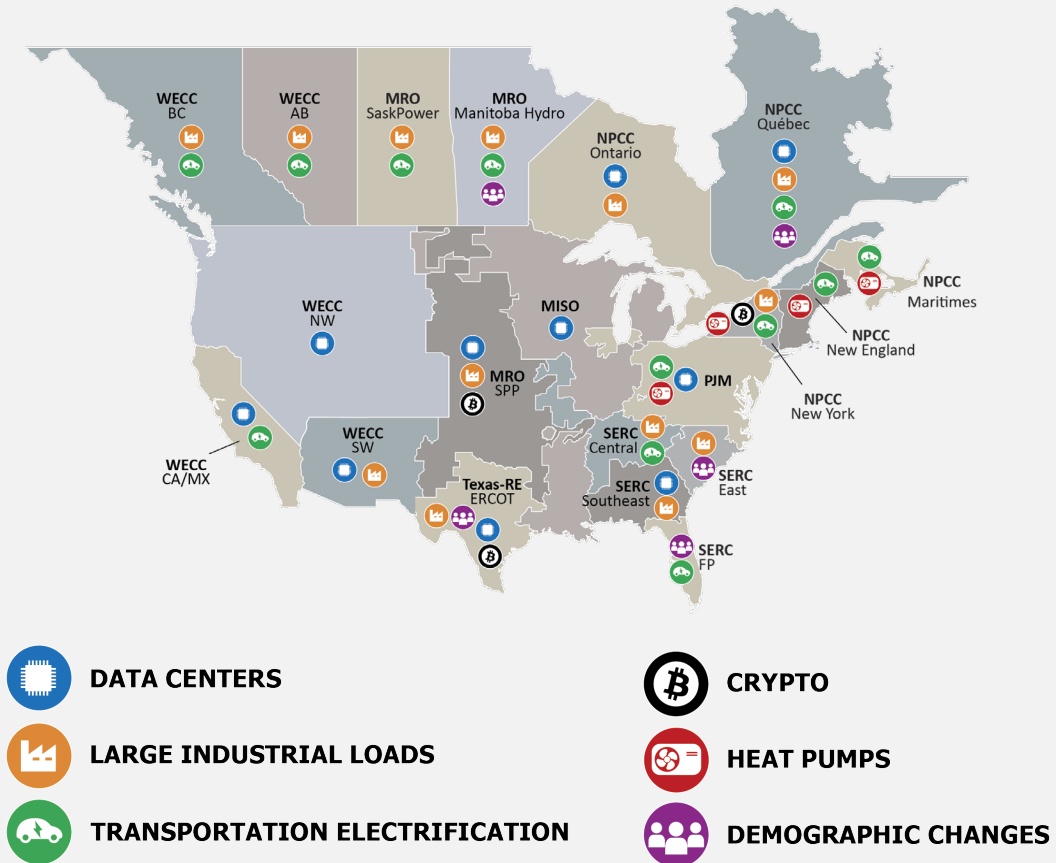
RELIABILITY | RESILIENCE | SECURITY

LLTF's Primary Objective:

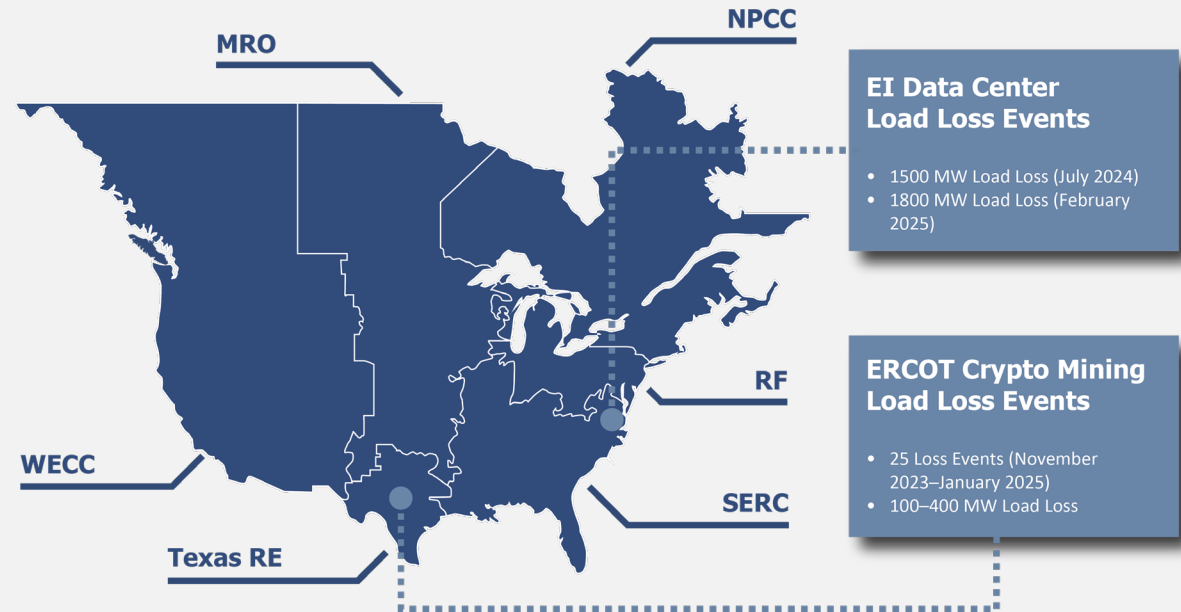
Understand the reliability impact(s) of emerging large loads on the BPS



Rapid Growth



System Events



Large Load Definition

*“Any **commercial or industrial individual load facility** or aggregation of load facilities **at a single site** behind one or more point(s) of interconnection **that can pose reliability risks to the BPS** due to its **demand, operational characteristics, or other factors**”*

- **No set demand threshold**
 - May be needed for Reliability Standards, Registration, state or federal regulation
 - Not appropriate for this set of papers
- **Risk is based on demand and operational characteristics**

Computational Load

- Data Centers
- Cryptocurrency Mining

Industrial Load

- Mining and Mineral Processing
- Metals and Heavy Manufacturing
- Semiconductors and Electronics Manufacturing
- Chemical and Petrochemical Processing
- Oil and Gas Production

Hydrogen Production Facilities



HIGH

Long Term Planning

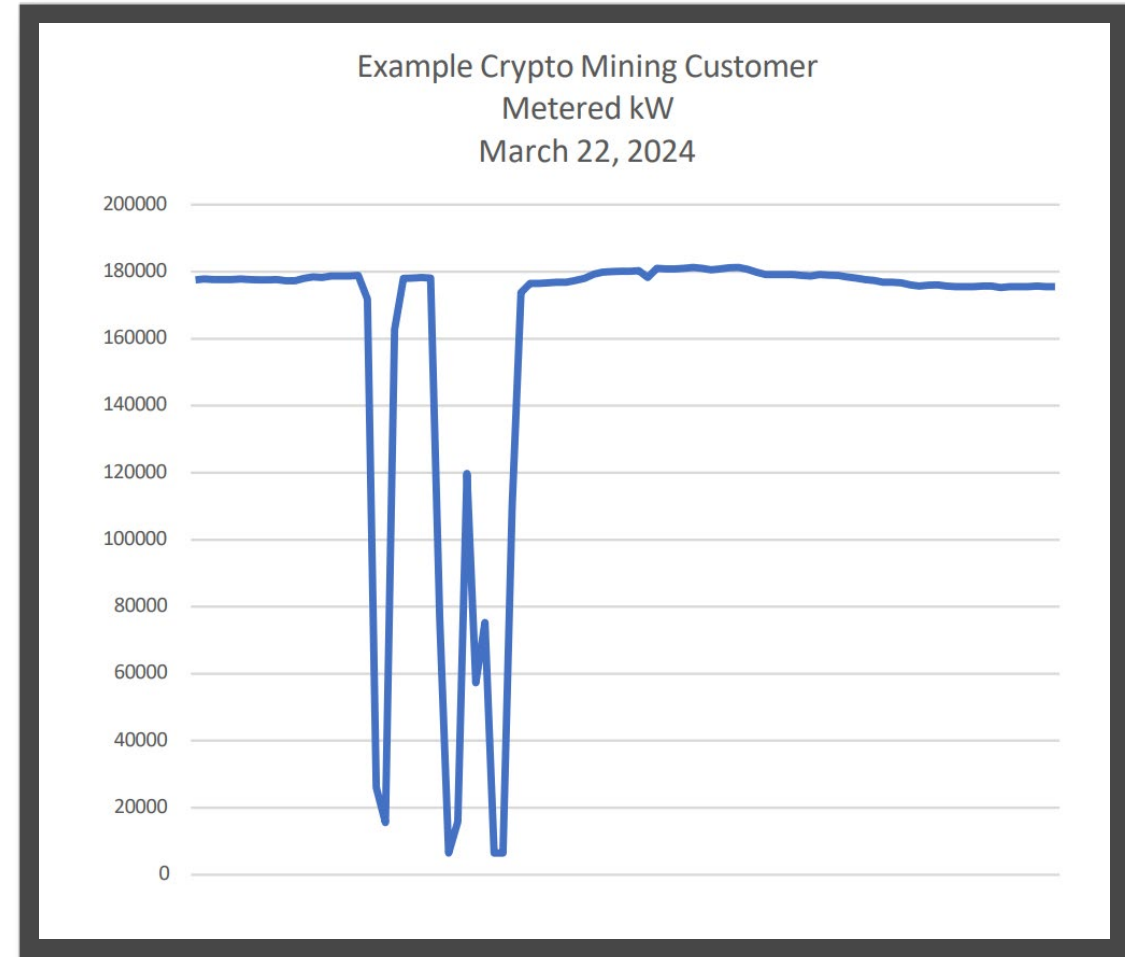
- Resource Adequacy

Operations/Balancing

- Balancing and Reserves

Stability

- Ride-through
- Voltage Stability
- Angular Stability
- Oscillations



Source: AEP presentation on October 8, 2024, LLTF Kickoff Meeting:
https://www.nerc.com/comm/RSTC/LLTF/LLTF_Kickoff_Presentations.pdf

Continue assessing gaps
in current processes and
Reliability Standards

Create Reliability
Guideline recommending
risk mitigations via
process improvement

Develop framework for
classifying large loads

Continue investigating
risks in:

- Load Modeling
- System Protection and Controls
- Energy Reliability Assessment



Interconnection Processes and Requirements



Planning and Resource Adequacy



Operations and Balancing



Ride-Through, Stability, and Power Quality Gaps



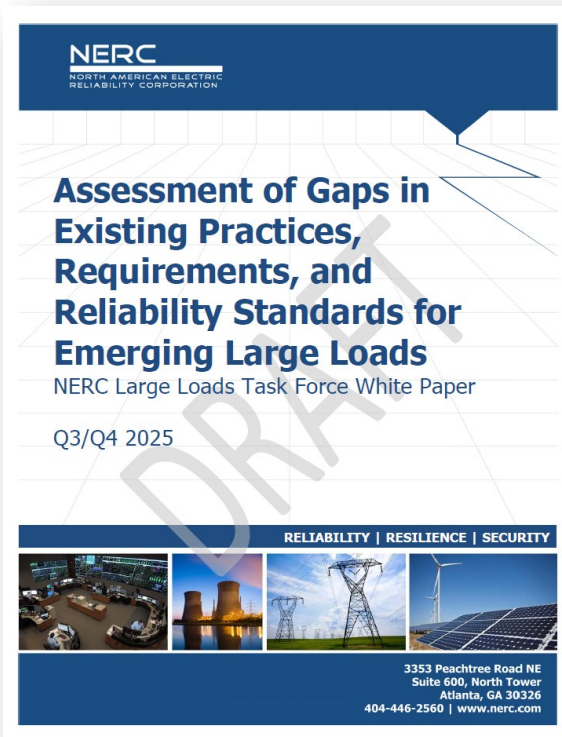
Security and Resilience Gaps



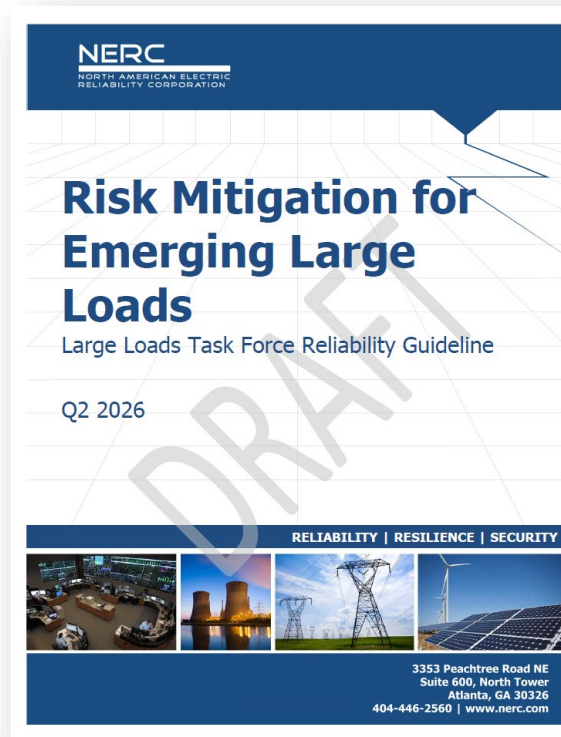
Modeling Gaps



Gap Analysis



Risk Mitigation



NERC Alert



A map of North America, including the United States, Canada, and Mexico. A horizontal band of three shades of blue (dark, medium, and light from top to bottom) stretches across the middle of the map, passing through the United States. The text "Questions and Answers" is centered within this band.

Questions and Answers

Large Load Integration Panelist



Chris Matos, Energy Market Development Strategic Negotiator at Google.

Chris is an energy and sustainability professional with a decade of experience in the electric utility industry, including expertise in wholesale power contracts, regulatory affairs, settlement models, and environmental markets. He has a strong project management background, successfully developing and implementing multi-billion-dollar resource plans. Chris is a graduate of the University of Texas at Austin, holding Master's degrees in Global Policy Studies and Energy and Earth Resources.



Goran Arya, Senior Manager, Global Renewable Energy, Equinix

Goran has over 15 years of experience in the renewable energy industry and currently works on Equinix's Global Renewable Energy and Cleantech team which works towards achieving Equinix's renewable energy goals and targets across the company's 270+ data centers across 35 markets. Goran's current role consists of origination activities across AMER and EMEA regions. Prior to Equinix, Goran has held senior roles in development, origination, and M&A with experience across solar, wind, hydropower, and energy storage technologies.



Nate Hill, Principal, Energy Policy, Amazon Web Services (AWS)

Nate leads energy policy and regulatory initiatives at the state, regional, and federal levels for Amazon Web Services. Prior to AWS, Nate led regulatory initiatives at Puget Sound Energy - a Pacific Northwest utility company. Nate also worked in the U.S. Senate in Washington D.C. as a legislative assistant focused on energy and natural resource policy, and holds a master's degree from the London School of Economics.

Panel Session on Gas-Electric Coordination

Action

Update

Background

The panel session will focus on the ongoing work and progress related to the Gas-Electric Work Plan that seeks to address the key risks associated with gas-electric coordination. It will include:

- A Canadian perspective on the gas industry and its coordination with the electricity industry presented by Mike Johnson, Technical Leader at the Canada Energy Regulator (CER).
- An update on the 2026 Gas-Electric Work Plan and associated refinements presented by John Moura, Director, Reliability Assessment and System Analysis at NERC.
- Remarks from gas industry representatives, including Chris Smith from the Interstate Natural Gas Association of America (INGAA), Jesse Sandlin from the American Exploration & Production Council (AXPC), and Matt Agen from the American Gas Associations (AGA).
- Open discussion with Board and Member Representative Committee (MRC).

Summary

Gas-electric coordination continues to be a key risk area during the energy transition as the role of natural-gas-fired generation becomes increasingly essential to provide the energy to meet load, grid essential reliability services, and the flexibility to integrate large amounts of variable energy resources such as wind and solar. The need for higher levels of coordination to address the interconnected risks between the two energy subsectors have been highlighted in multiple “cold weather event” investigations by NERC and FERC, notably 2021’s [Winter Storm Uri](#) and 2023’s [Winter Storm Elliott](#) reports.

For its part, NERC continues to collaborate extensively with industry and policymakers. NERC has enhanced its Reliability Standards to prepare generators for winter extremes, implement training, and establish communication protocols between generators and grid operators. Current standards projects encompass extreme weather planning and energy assurance requirements. NERC’s reliability assessments, including the [2024 Long-Term Reliability Assessment](#) and [2024-2025 Winter Reliability Assessment](#), both published in late 2024, continued to highlight the risks associated with the increasing dependence on natural gas systems and promote gas-electric system coordination. In January 2025, the Northeast Power Coordinating Council (NPCC) published a study¹ underscoring how natural gas dependency in New England and New York poses a high risk for electric reliability during extreme winter weather under certain circumstances. This study was informed by contributions from a diverse steering committee comprised of electric and gas systems operators, the Northeast Gas Association, NPCC, and NERC. [NERC’s February 2025 Reliability Leadership Summit](#) also highlighted the need for continued focus on gas-electric coordination.

¹ [Northeast Gas/Electric System Study](#)

In March 2025, NERC released [Reliability Insights: The Interconnected Gas and Electric Systems](#) summarizing the implications of the increased level of connectivity between the electric and gas systems. In the document, NERC identified four key reliability risks: (1) natural gas supply and transportation risks; (2) electric and gas market harmonization; (3) resource adequacy and capacity to support large variability in load and resources; and (4) the lack of comprehensive generator winterization. NERC also highlighted opportunities for mitigation related to enhanced winterization requirements; operational preparedness; improved communication protocols; market reforms; cross-market coordination; capacity and energy planning for ramps; and regulatory reform.

In preparation for the May 2025 NERC Board of Trustees meeting, the Board requested feedback from the MRC on a draft work plan to address the risks identified in the Reliability Insights. The Board received [extensive feedback](#), which included recommended updates such as targeted risk assessments and modeling, improving communication protocols, and emphasizing coordination and collaboration.

In addition, the [Quarterly Technical Session](#) at the May 2025 Board of Trustees meeting featured a segment on gas-electric coordination with panel topics including the *Northeast Electric/Gas System Study* and implications, wellhead winterization, electric/gas market and operational coordination, and NERC's Work Plan. These panels included gas industry representatives and advanced a valuable understanding of key aspects of their industry that affect gas-electric coordination considerations.

The Board will host further discussions about gas-electric coordination efforts and the work plan at its August 2025 meeting. At the Quarterly Technical Session, gas industry representatives will provide additional critical perspectives, and NERC staff will share work plan updates and a draft strategy document that outlines how these gas-electric coordination efforts will advance.

Draft Strategy Document

The draft *Electricity-Natural Gas Strategy* - included in the background documents - outlines NERC's approach to addressing the aforementioned interdependence between the electric and natural gas systems, based on input from the MRC. The strategy is structured around a core framework of identifying, assessing, and mitigating risks, and will be implemented through NERC's Risk Framework and annual work plan priorities.

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

Prioritizing Gas-Electric Interdependency Risks and Mitigation Efforts

NERC's Work Plan and Activities

John Moura, Director, Reliability Assessment and Performance Analysis

NERC Quarterly Technical Session

August 13, 2025

RELIABILITY | RESILIENCE | SECURITY

Natural Gas Supply and Transportation Risks

- Production Well Freeze-Offs and Winterization
- Dependence on Electricity
- Pipeline Constraints
- Facility Outage / Disruption

Resource Adequacy and Capacity to Support Large Ramps Risks

- Resource Performance During Winter Peak Demand
- Generation Preparedness and Fuel Assurance

Electric and Gas Market Harmonization Risks

- Fuel and Transportation Scheduling
- Unit Commitment
- Operational Coordination
- Planning Coordination

Vulnerabilities in Generator Winterization Risks

- Implementation Challenges
- Actual Winter Conditions More Severe than Design Capability
- Back-up Fuel Unavailability

Mitigation Opportunities

- Enhanced Winterization Requirements
- Capacity and Energy Planning Improvements
- Operational Preparedness
- Improved Communication Protocols
- Market Reforms
- Cross-Market Coordination
- Regulatory Coordination

Mitigations
we can lead

**NERC-Driven
Initiatives**

Compliance
Monitoring

Standards
Development
Projects

Performance
Analysis,
Event Reviews

Objective
insights from
assessments

**Study-Driven
Initiatives**

BPS
Situational
Awareness
Tools

Long-Term
Reliability
Assessment
Enhancements

Special
Studies and
Coalitions

Supporting
our partners

**Engagement-
Driven
Initiatives**

Natural Gas
Industry

Regulatory
Coordination

Market
Reforms

- **New Initiative:** Conduct studies/forums that assess the adequacy of gas infrastructure to meet future electric demand (e.g., data centers). Tailor risk assessments and mitigation strategies to reflect regional gas infrastructure constraints.
- **New Initiative:** Examine balancing authority generation commitment and scheduling, as these practices significantly affect gas-electric coordination. This includes examining Operating Reserve-related requirements under a variety of conditions. Support the advancement of a standard authorization request.
- **New Initiative:** Support the development of a framework for real-time data sharing and coordination protocols between gas and electric system operators (i.e., event analysis, guidelines, etc.).
- **Reprioritize:** Elevate “Improved Communication Protocols” to a top-tier initiative.
- **Update:** Provide detailed guidance on EOP-012-3 exceptions and compliance expectations.
- **Update:** Reframe “Regulatory Reform” to focus on coordination and information sharing rather than structural changes.

- Complete Reliability Standards project requiring energy reliability assessments for the long-term planning
- Identify potential enhancements to NERC Reliability Standards regarding operational reserves, unit commitment, and scheduling needs
- Guidelines for natural gas pipeline and production wellhead winterization
- Improvements to NERC Long-Term Reliability Assessments capturing natural gas fuel availability risk
- Assess the adequacy of natural gas infrastructure to meet future electricity demand and generation needs through tailored regional studies
- Improve operational data sharing and coordination protocols between gas and electric system operators



Questions and Answers

Gas-Electric Coordination Panelist



Chris Smith, Regulatory Counsel, Interstate Natural Gas Association of America (“INGAA”)

Chris has worked at INGAA since April 2021. Prior to joining INGAA, Chris worked as a senior associate in the Washington, D.C. office of Gibson, Dunn & Crutcher, where he counseled companies in connection with FERC enforcement proceedings as well as litigation before federal and state courts, other federal agencies, and arbitral panels. Chris received a Bachelor of Science degree in Mathematical Economics from Haverford College and his law degree from New York University.



Jesse Sandlin, the Director of Policy and Regulatory Affairs at American Exploration & Production Council (AXPC)

As AXPC’s Director of Policy and Regulatory Affairs, Jesse Sandlin leads AXPC’s efforts in policy engagement on Air, Climate, Water, and Waste issues, and supports AXPC’s ESG efforts. Before joining AXPC, Jesse spent 14 years working in the oil and gas sector for Devon, Noble Energy, and most recently Chevron. Jesse holds a Bachelor of Science in Chemical Engineering from the University of Oklahoma and a Juris Doctor from Emory University, and uses the combination of technical and legal skills to advocate for policy priorities that strengthen American energy production to enable people around the world to flourish.



Matt Agen, Chief Regulatory Counsel, Energy at the American Gas Association

Mr. Agen is an energy attorney with over twenty years of experience in the private sector and with the federal government. Mr. Agen has extensive experience advising and representing natural gas distribution companies, oil pipelines, natural gas pipelines, and electric utilities in a variety of federal regulatory and transactional matters arising under the Natural Gas Act, Interstate Commerce Act, and Federal Power Act before the Federal Energy Regulatory Commission (FERC). Mr. Agen serves on the Board of Directors for the North American Energy Standards Board and as an Associate Member of the CFTC’s Energy and Environmental Markets Advisory Committee. Mr. Agen is a past Chair of the Energy Bar Association’s Gas, Oil & Liquids Steering Committee.

The NERC logo consists of the letters "NERC" in a bold, black, sans-serif font. A horizontal blue bar is positioned directly beneath the text.

NERC

NORTH AMERICAN ELECTRIC
RELIABILITY CORPORATION

NERC Electric/Gas Efforts Updated Work Plan

August 2025

RELIABILITY | RESILIENCE | SECURITY

1. Natural Gas Supply and Transportation Risks

- Production Well Freeze-Offs and Winterization
- Dependence on Electricity
- Pipeline Constraints
- Facility Outage / Disruption

3. Resource Adequacy and Capacity to Support Large Ramps Risks

- Resource Performance During Winter Peak Demand
- Generation Preparedness and Fuel Assurance

2. Electric and Gas Market Harmonization Risks

- Fuel and Transportation Scheduling
- Unit Commitment
- Operational Coordination
- Planning Coordination

4. Vulnerabilities in Generator Winterization Risks

- Implementation Challenges
- Actual Winter Conditions More Severe than Design Capability
- Back-up Fuel Unavailability

Mitigation Opportunities

- Enhanced Winterization
- Capacity and Energy Planning Enhancements
- Operational Coordination and Preparedness
- Improved Communication Protocols
- Market Reforms
- Cross-Market and Regulatory Coordination

NERC-Driven Initiatives

Mitigations
we can lead

Study-Driven Initiatives

Objective
insights from
assessments

Engagement-Driven Initiatives

Supporting
our partners

NERC-Driven Initiatives

Enhanced Winterization

Initiative	Description	Lead	Timeline
Compliance with mandatory generator winterization requirements	<ul style="list-style-type: none"> Engage proactively with industry ahead of standard effective dates through Small Group Advisory Sessions to provide implementation guidance. Special emphasis on EOP-012-3 exceptions and compliance expectations Continued focus through the CMEP Implementation Plan (CMEP IP) with a variety of tools being used (e.g., Audits, Spot Checks, Self-Certifications) 	CMEP	Ongoing
Gas generator performance during extreme cold events	Annually evaluate performance through assessment of GADS and EIA data and published in State of Reliability report, winter performance reviews, and other post-event analysis	Event Analysis	Q2 – 2025, As needed
Voluntary pipeline and production wellhead winterization guidelines	Develop a best practices document that summarizes winterization guidelines in the gas upstream and midstream sectors and highlights recommendations on sustaining the practices	Engineering	Ongoing

Capacity and Energy Planning Enhancements

Initiative	Description	Lead	Timeline
Next state of energy assurance standards	<ul style="list-style-type: none"> Advance project 2023-08 that ensures various forms of historical and forecast demand, energy data, and information for reliability studies and assessments Advance project 2024-02 that requires energy reliability assessments for the Long-Term Planning horizon including availability of fuel 	Standards	Ongoing

NERC-Driven Initiatives

Operational Coordination and Preparedness

Initiative	Description	Lead	Timeline
New gas situational awareness tools	Implement new tools that support monitoring of critical gas assets impacting BPS operations	BPSA	Q4 – 2025
Monitoring through DNG-ISAC coordination	Support the Downline Natural Gas Information Sharing and Analysis Center through contract	E-ISAC	Ongoing
Identify potential enhancements to Reliability Standards	Examine how Balancing Authorities commit and schedule generation, identify gaps and support advancement of standard authorization requests (SAR); and Consider enhancements to Reliability Standards that focus on Balancing Authorities role in providing Operating Reserves and plans to have access to fuel to support reserves	Standards	Q1 - 2026

Improved Communication Protocols

Initiative	Description	Lead	Timeline
Real-Time data sharing and coordination protocols	Support the development of a framework for real-time data sharing and coordination protocols between gas and electric system operators (i.e., event analysis, guidelines)	TBD	TBD
AGA/NARUC's Natural Gas Readiness Forum	Support NARUC/AGA's Readiness Forum who fosters operational education, situational awareness and peer-to-peer connections across the entire natural gas industry, electric sector, and federal and state government and end-users	RAPA, BPSA	Ongoing

Study-Driven Initiatives

Capacity and Energy Planning Enhancements

Initiative	Description	Lead	Timeline
Enhanced energy analysis supporting reliability assessments	Investigate and select an industry modeling tool to enhance gas availability characteristics (e.g., ServM) to incorporate natural gas risk analysis into NERC assessments	RAPA	Pilot Complete 2025
Gas infrastructure adequacy studies	<ul style="list-style-type: none"> Conduct and/or support studies that assess the adequacy of gas infrastructure to meet future electric demand and its operating characteristics (i.e., impact of renewable and gas-fired plants on gas pipeline pressures (up/down ramps) during system operations and contingencies. Tailor studies to reflect regional gas infrastructure dynamics and constraints 	RAPA	Ongoing
Additional analysis on key gas system contingencies	Leverage analytical tools from NPCC study on gas contingencies in New England and New York and expand analysis to all other regions in North America	RAPA	Ongoing

Engagement-Driven Initiatives

Market Reforms, Cross-Market and Regulatory Coordination

Initiative	Description	Lead	Timeline
Natural Gas Reliability Jurisdictional Construct	Confirming scope of NERC authority, as well as other regulatory agencies such as FERC	Legal	2025
Gas Industry Engagement & Collaboration	Continue to discuss NERC's risk mitigation strategies with key gas trades (AGA, INGAA, NGSA, AXPC, Marcellus Shale Coalition) through different engagement strategies	External Engagement	Ongoing
FERC Engagement & Collaboration	Continue to explore implementation of lessons learned and explore opportunities for joint efforts/engagements	External Engagement	Ongoing
Canadian Gas-Electric Efforts	Support voluntary industry efforts to increase gas/electric coordination in Canada	External Engagement	Ongoing

Electricity-Natural Gas Strategy

Ensuring the Reliability of the Interconnected Bulk Power and Natural Gas and Systems

August 2025 - DRAFT

Purpose

This document outlines NERC's strategy to identify, assess, and facilitate ongoing and future mitigation of the risks that arise from the growing reliance on natural gas for electricity generation. NERC's strategy also seeks to increase the coordination of the natural gas and electric infrastructure and ensure a more reliable, resilient, and secure bulk power system (BPS).

The electric industry's increased dependence on natural gas to fuel electricity generation amplifies its vulnerability to disruptions in natural gas supply, transportation, and delivery.

Background

As the electric industry undergoes significant and rapid changes, new challenges and opportunities arise for reliability, security, and resilience. In 2023, utility-scale system power plants with at least 1 megawatt (MW) of electric power generator capacity produced about 4,183 terawatt hours (TWh) of electricity. Natural gas-fired generation averaged 1,806 TWh (43.2% of the generation mix), making it the largest single source of energy for U.S. electricity generation.¹ According to the latest available data, gas-fired generation in 2024 surpassed the 2023 totals. These trends have spanned the past two decades, over which the gas-fueled share for electricity generation has doubled. This has resulted in the electricity sector becoming the largest consumer of natural gas, leading to increased interdependence between the two industries and requiring enhanced coordination—particularly during extreme cold weather events.²

Over the past 11 years, North America has endured five widespread extreme cold events³ that highlighted electricity-gas interdependence and its impact on BPS reliability. Winter Storm Elliott further highlighted that the electric grid and natural gas pipeline network are two subsystems of a larger interconnected bulk energy system, revealing a need to evolve the reliability strategy. Impacts on reliability have become more evident as the gas and electricity systems become increasingly integrated. As a result, NERC has called for formalized coordination and collaboration between the two industries.⁴ The growing importance of coordination between the gas and electricity industry regulators and their respective stakeholders has culminated in a range of initiatives and reports spanning multiple organizations and regulatory bodies.

¹ [Electricity data browser - Net generation for all sectors](#).

² Researchers at Carnegie Mellon University (Smillie, Morgan, and Apt, 2023) suggest that 10% of the critical compressor stations that help regulate natural gas flow through the U.S.'s large interstate natural gas pipelines are either fully or partially dependent on electric drivers. [How vulnerable are US natural gas pipelines to electric outages?](#)

³ The December 2022 Winter Storm Elliott Event, the February 2021 Winter Storm Uri Event, the January 2018 Event, the January 2014 Polar Vortex Event, and the February 2011 Winter Event.

⁴ (Robb, Jim and Lauby, Mark, 2024) [Gas-Electric Systems Evolve Beyond Interdependency](#), Fortnightly Magazine.

The North American Energy Standards Board (NAESB) states in its *Gas-Electric Harmonization Report* that there are measures the electric and natural gas industries can take with policymakers and other stakeholders to enhance natural gas-electric coordination. Several recommendations are activities that natural gas and electric utility participants, state and federal regulators, NAESB, or other stakeholders might pursue in concert. For example, the report calls for standards that encompass the interconnected bulk energy system and the deep need for coordination between both energy subsystems to ensure their reliable operation.⁵

In addition, NERC is pursuing actions within the scope of Section 215 of the Federal Power Act to enhance the reliability and resilience of the BPS as the electricity sector increases its dependence on natural gas. This includes assessments, data collection, industry alerts, Reliability and Security Guidelines, and Reliability Standards applicable to electric power generators that rely on natural gas.

NERC can also work with gas and electricity industry stakeholders to create comprehensive models to better understand the independence of the gas and electric systems in each of the Regional Entities footprints, similar to the *NPCC Northeast Gas-Electric System Study*.⁶

NERC actively engages with external stakeholders to identify, assess, and mitigate risks by:

- Coordinating with the natural gas industry
- Informing regulatory reform
- Informing state/provincial policy
- Engaging national laboratories and other critical stakeholders

Identified Risks

The natural gas and electric systems are constituent parts of an interconnected energy delivery system. High-profile disruptions to natural gas availability in recent years have raised awareness of the interdependence between the natural gas system and the BPS infrastructure, resulting in calls for closer coordination in planning and operating these two systems to identify and mitigate risk. Key risks identified by NERC are:

- **Natural Gas Supply and Transportation Risks**
 - Production Well Freeze-Offs and Winterization: During extreme cold, natural gas wells can freeze, leading to significant reductions in supply.
 - Dependence on Electricity: Upstream and midstream gas facilities (compressors, processing plants, and wellheads) rely on electricity from the grid to operate.
 - Pipeline Constraints: Constrained pipeline capacity, particularly in the U.S. Mid-Atlantic and Northeast, poses challenges in delivering natural gas during peak demand, leaving little operational flexibility should any natural gas facilities be out of service.

⁵ [Gas Electric Harmonization Forum Report](#), July 28, 2023

⁶ [NPCC Northeast Gas-Electric System Study](#), January 21, 2025

- **Electric and Gas Market Harmonization**
 - **Scheduling:** Discrepancies between gas and electric market schedules can lead to delays in natural gas availability for power generation during peak demand.
 - **Operational Coordination:** Inadequate communication between market operators and pipeline operators prevents alignment of resource availability and electricity demand.
 - **Planning Coordination:** Gas and electric system planning is not integrated, and assessments of infrastructure are needed to assure the reliability and adequacy of both systems.
- **Resource Adequacy and Capacity to Support Large Ramps**
 - **Winter Peak Demand:** Extreme cold can cause sharp increases in electricity demand during the morning and evening hours, requiring generation resources to ramp up quickly.
 - **Generation Preparedness and Fuel Assurance:** Natural gas power plants that are ill-prepared for rapid ramping may fail to secure fuel in real-time conditions.
- **Vulnerabilities in Generator Winterization**
 - **Implementation Challenges:** Despite recent progress, some generators still face challenges implementing comprehensive winterization measures.
 - **Back-up Fuel Unavailability:** Back-up fuel—mainly oil supplies—may be limited due to inventory and/or refueling challenges.

Mitigation Opportunities

Recent events have underscored the urgency of addressing systemic vulnerabilities through a coordinated, forward-looking approach. Key mitigation opportunities that NERC and its stakeholders can pursue to strengthen operational readiness, enhance planning frameworks, and align regulatory and market structures with the demands of a rapidly changing grid environment include:

1. **Enhanced Winterization Requirements:** Strengthen the resilience of generation and transmission assets against extreme cold weather events.
2. **Capacity and Energy Planning Improvements:** Ensure sufficient resource adequacy and flexibility to meet evolving demand profiles and extreme weather scenarios. Also, promote probabilistic and scenario-based resource adequacy assessments.
3. **Operational Preparedness:** Enhance real-time situational awareness and readiness for high-impact, low-frequency events.
4. **Improved Communication Protocols:** Strengthen internal and external communication during grid emergencies.
5. **Market Reforms:** Align market incentives with reliability and resilience objectives, which includes evaluating capacity market designs to ensure they support resource adequacy, addressing price formation issues that may discourage investment in firm capacity, and promoting mechanisms that value flexibility, ramping, and fuel assurance.

6. **Cross-Market Coordination:** Improve reliability through better alignment of operations and planning across market seams.
7. **Regulatory Coordination:** Foster alignment between federal, state, and regional regulatory frameworks to support reliability.

Core Tenets of the Strategy

NERC and the six Regional Entities, collectively the Electric Reliability Organization (ERO) Enterprise, proactively identify, assess, and mitigate the risks through the following *Electricity-Natural Gas Strategy*. While this strategy is centered on activities pursued in coordination with NERC Registered Entities and Members, NERC recognizes the opportunities to partner with other regulatory authorities and natural gas industry organization in considering its recommendations. [Figure 1](#) provides the core tenets of this risk mitigation strategy, balancing near-and-long-term approaches to ensure the reliable operation of the BPS.

ERO Enterprise Strategy		
IDENTIFY THE RISK	ASSESS AND PRIORITIZE THE RISK	MITIGATE AND REMEDIATE THE RISK
Periodic Benchmarking	Data Collection	Webinars and Workshops
Reliability Assessments	Modeling Tools	Establish Monitoring Criteria
Performance Analysis	Create and Refine Scenarios	Guidelines
Event Analysis	Interdependency Criteria	Alerts
Joint Inquiry Reports	Modeling and Study Improvements	Standard Development

Figure 1: ERO Enterprise Core Tenets Strategy

The following sections describe the essential actions for implementing NERC's risk mitigation strategy ([Figure 1](#)).

Identify the Risk

- Leverage and enhance analytic capabilities with respect to interconnected energy infrastructures
- Analyze normal and stressed operating conditions to identify existing and future potential electricity-natural gas issues
- Deepen the understanding of the interconnected energy systems in coordination with the scientific community, regulatory organizations, and energy users, owners, and operators
- Establish benchmarks/metrics to assess gas availability risks

- Continue using NERC’s Risk Issues Steering Committee’s input and risk identification framework

Assess and Prioritize the Risk

- Refine, document, and disseminate knowledge regarding the appropriate use of interdependency benchmarks, metrics, and criteria in risk studies
- Survey, benchmark, and assess available data sources (in collaboration with the natural gas industry) to understand which are appropriate for electricity-gas studies, and establish processes to incorporate those data into studies
- Draw on real-time and historical data to create and refine scenarios that reflect realistic seasonal operating conditions and extreme events between the interconnected energy subsystems
- Enhance understanding of the regional factors that influence model selection, inputs and outputs, and most relevant use cases for modeling tools
- Iteratively improve the studies by incorporating lessons learned from study execution and NERC and industry stakeholder feedback
- Strengthen skills related to the interpretation and translation of study results into actionable mitigation insights and strategies

Remediate and Mitigate the Risk

- Enable stakeholders to make informed decisions on infrastructure development, strategic investments, and the effective mitigation of risks associated with significant disruptions through education and outreach
- Work with industry stakeholders to establish monitoring criteria and mechanisms to evaluate their efficacy
- Collaborate with natural gas industry stakeholders to help foster mutual objectives on addressing risks to the interconnected energy delivery systems

Conclusion and Next Steps

This strategy will be implemented within NERC’s Risk Framework and in concert with its annual Work Plan Priorities, as well as through its stakeholder engagement. Next steps will be to communicate, engage, and socialize NERC’s activities that operationalize this strategy and the specific activities that aim to reduce risk associated with electricity and natural gas interdependence.

NERC Bulk Power System Awareness Update

Action

Information

Background

NERC's Bulk Power System Awareness (BPSA) group acquires and disseminates timely, accurate, and complete information regarding the status of the bulk power system (BPS) and threats to its reliable operation, to enable ERO Enterprise to effectively assure the reliability of the BPS. During major system disturbances, extreme weather, fires, hurricanes, physical events, and geomagnetic disturbances, etc. the BPSA facilitates effective communications between the ERO Enterprise, industry, and government stakeholders.

NERC BPSA, in collaboration with the E-ISAC and the ERO Enterprise Situation Awareness teams, maintains a near real-time situation awareness of conditions on the BPS. Notifies the Industry of significant BPS events that have occurred in one area, and which have the potential to impact reliability in other areas. Maintains and strengthens high-level communications, coordination, and cooperation with governments and government agencies regarding real-time conditions.

Summary

The BPS remained stable throughout Q1 2025. Despite several significant events—including a geomagnetic storm, extreme cold weather, and wildfires in Southern California—the NERC BPSA team provided regular updates to ERO leadership, FERC, and the DOE on the status of the BPS during these events.

- **January Geomagnetic Storm:** A Kp-8 level geomagnetic storm was observed by NOAA's Space Weather Prediction Center. The SWPC initiated the Reliability Coordinator (RCs) conference call with the RCs.
- **Extreme Cold Weather:** Severe cold affected central Canada the Central Great Plains, Ohio and Tennessee Valleys, and the Mid-Atlantic region. January and February saw multiple extreme weather events across most of North America.
- **Southern California Wildfires:** Numerous wildfires occurred due to a combination of dry vegetation, low humidity, strong Santa Ana winds, and generally unfavorable fire weather conditions.
- **March–April Load Shed Events:** Load shedding occurred across the SPP and MISO footprints due to multiple weather-related forced outages, scheduled generation outages, and low wind generation.
 - MISO shed ~600 MW.
 - SPP shed 122 MW.

Registered entities postured the system to ensure reliability and implemented operating procedures during these events.