NARUC
National Association of Regulatory Utility Commissioners

Grid Reliability and U.S. Coal Fleet Attributes: Considerations for State Regulators

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- **John Brewer,** National Energy Technology Laboratory
- **Asim Haque,** PJM
- **Fritz Hirst,** North American Electric Reliability Corporation
- **Kirk Labarbara,** National Energy Technology Laboratory
- **Will McCurry,** North American Electric Reliability Corporation
- **John Moura,** North American Electric Reliability Corporation
- **Mark Olson,** North American Electric Reliability Corporation
- **Asanga Perera,** PJM
- **Tom Sarkus,** National Energy Technology Laboratory
- **Danielle Sass Byrnett,** NARUC
- **Jerry Terry,** MISO
- **Hon. Mary Throne,** Wyoming Public Service Commission
- **Kerry Valley,** MISO

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Reliability and resilience are paramount concerns for U.S. state utility regulators, especially in light of the increasing volatility in supply and demand, frequency of extreme weather events that strain the power grid, and forecasted high growth in demand in the coming years driven by growth in artificial intelligence, electrification, and manufacturing. The landscape is further complicated by expected, proposed, and recently finalized federal and state regulations, along with clean energy goals, which have prompted many vertically integrated utilities and competitive power producers to retire coal-fired generation plants earlier than originally planned, often before the end of their useful operational life. Recently, the U.S. Department of Energy (DOE) has exercised its authorities under section 202(c) of the Federal Power Act to direct grid operators to keep specific coal, oil, and natural gas generating units operating past announced retirement dates, "minimizing any potential generation shortfall that could lead to unnecessary power outages" (U.S. Department of Energy, n.d.).

This briefing paper provides state utility regulators with a comprehensive and current understanding of the reliability attributes of coal as a generation resource, potential reliability impacts associated with near-term coal plant retirements, and possible mitigation strategies to ensure a stable and resilient energy system.

I. Executive Summary

The U.S. power sector is undergoing a profound transformation driven by technology, policy, regulatory, and market forces. This transition poses complex challenges for state utility regulators, particularly in ensuring grid reliability.

In coming years, the energy landscape will undergo further significant changes, with intermittent renewable generation and energy storage systems projected to dominate newly installed power generation (U.S. Energy Information Administration, February 2024a). Concurrently, the gradual retirement of aging (mostly coal) thermal power plants will further accelerate this shift, increasing the complexity of the energy transition and increasing volatility risks to reliability. The North American Electric Reliability Corporation (NERC) has repeatedly warned of mounting long-term resource adequacy challenges as thermal generator retirements continue (North American Electric Reliability Corporation, 2024). In seasonal reliability assessments, certain regions are at elevated risk for near-term generation shortfalls during abnormal weather such as prolonged hot or cold weather events (North American Electric Reliability Corporation, May 2025). Intermittent generation tends to be less available during such events. Concurrently, NERC has worked to put cold weather reliability standards in place to improve thermal generators' ability to withstand cold snaps (North American Electric Reliability Corporation, April 2025).

In this evolving context, maintaining a reliable bulk power system requires sustained focus and proactive measures to ensure that the energy generation mix can meet the capacity, energy, and essential reliability service demands under diverse operational conditions. Severe extreme weather events are already placing stress on certain regions; projected load growth from data centers, industrial reshoring, and transportation and building electrification will exacerbate these challenges. In addition to more generation to serve growing demand, maintaining reliability will necessitate enhancements to current planning processes, substantial expansion of the transmission network, and increased transmission and distribution integration and coordination, enabling efficient electricity delivery from decentralized power sources to growing load centers, while enhancing system resilience against disruptions.

According to the U.S. Energy Information Administration (EIA), coal contributed 16 percent to U.S. electricity generation in 2023 (U.S. Energy Information Administration, February 2024b), a sharp decline from its peak at over 54 percent in 1990 (U.S. Environmental Protection Agency, January 2025). However, coal dependency varies by state, with 10 states relying on coal as their largest source of power generation, as reported by the EIA in 2023 (Popovich, 2024).

This briefing paper examines the role of coal-fired power plants in grid reliability, the impacts of declining coal capacity on grid reliability, and considerations for state utility regulators responsible for reliability, safety, and affordability of electricity delivery.

Key points addressed in this paper include:

1. Reiterating essential reliability attributes of the grid, including inertia, frequency response, and voltage support and the role that coal generation plays in each.
2. Concerns raised by NERC regarding the potential reliability impacts of accelerated coal plant retirements.
3. Strategies different entities can employ for maintaining grid reliability during the energy transition, including the role of emerging technologies and the need for comprehensive and enhanced transmission planning.

This paper aims to equip state utility regulators with a valuable understanding of the challenges and considerations surrounding thermal generation and grid reliability. It emphasizes the importance of balancing policy goals with the need for a stable and resilient power system which delivers affordable electricity, highlighting the complex decisions utility regulators face in this rapidly evolving energy landscape.

II. Reliability Attributes, Risk Factors, and Performance

Reliability attributes are the critical characteristics or capabilities provided to the overall power system by the interconnected generation resources to ensure the stable, secure, and continuous operation of the electrical grid. These attributes are essential for maintaining the balance between supply and demand, managing frequency and voltage levels, and ensuring the overall stability and reliability of the power system under normal and contingency conditions.

The definitions and classifications of power system reliability attributes differ slightly from institution to institution but overall, the power-industry-defined reliability attributes related to individual plants or portfolios can be summarized as resource adequacy contribution, and the ability to provide essential reliability services (ERS) such as frequency response, regulation and ramping capability, voltage support and reactive power, and black start capability.

Individual plants contribute differently to reliability attributes, based on their technology and design. For example, conventional, large nuclear plants provide a consistent contribution to resource adequacy and inertia but are less flexible than other resources in ramping. Conversely, small simple cycle natural gas plants offer excellent ramping and frequency response capabilities but may be more vulnerable to fuel supply issues that affect their contribution to resource adequacy, compared to other resources.

At the portfolio level, reliability attributes are primarily managed through diversification of generation resources. A portfolio with a mix of baseload plants (e.g., nuclear and coal), flexible peaking plants (e.g., natural gas and hydro), and renewable resources with diverse transmission interconnection can be readily managed to provide a balanced approach to resource adequacy, frequency response, and voltage support. Additionally, the integration of energy storage, demand response, load management, and advanced grid management systems enhances the overall reliability and resilience of power systems.

The following is an overview of six key reliability attributes at the plant and portfolio levels:

Resource Adequacy: Resource adequacy refers to the ability of the power system to have sufficient capacity and reserves to meet demand at all times, including during peak periods and during planned and unplanned outages of generation or transmission facilities.[1]

- **Plant Level:** At the individual plant level, resource adequacy contribution is determined by the plant's capacity factor, availability, and reliability. A high-capacity factor plant (e.g., nuclear or coal) is predicted to be consistently available to supply power, which contributes positively to resource adequacy.
- **Portfolio Level:** At the portfolio level, resource adequacy is traditionally achieved by having a sufficient and diverse mix of generation technologies that can collectively meet demand under various conditions. This includes baseload plants, peaking plants, demand-side management, and energy storage systems to manage intermittent generation sources in addition to covering different load profiles and contingencies.

Frequency Response: Frequency response is the ability of the power system to stabilize frequency following a disturbance, such as a sudden loss of generation or change in load. It is a measure of how quickly and effectively generation resources can adjust their output to correct frequency deviations.

1 For an in-depth discussion of current and emerging approaches to manage resource adequacy and state involvement in decision making, see Nethercutt, E., *Resource Adequacy for State Utility Regulators: Current Practices and Emerging Reforms*, NARUC, November 2023, https://pubs.naruc.org/pub/0CC6285D-A813-1819-5337-BC750CD704E3.

- **Plant Level:** Synchronous generators with necessary control systems (automatic generation control, or AGC) can provide frequency response reserves (e.g., primary, secondary, and tertiary reserves[2]) by adjusting generator output in response to frequency deviations and either automatic or manual control mechanisms. In addition, battery systems can provide very fast frequency response (FFR) if designed and incentivized for this purpose.
- **Portfolio Level:** A portfolio that includes enough fast-responding resources (e.g., gas turbines, hydro, and batteries) is crucial for maintaining frequency stability. A mix of such resources may also improve reliability, owing to the benefits of diversification.

Inertia: Inertia is the kinetic energy stored in the rotating mass of generators and turbines that helps stabilize grid frequency immediately after a disturbance by slowing the rate of change of frequency (RoCoF). Inertia is the first line of defense for grid stability and is historically triggered without the need for a control mechanism, as it is a natural byproduct of the physical nature of a rotating mass.[3]

- **Plant Level:** Synchronous generators (e.g., coal, nuclear, gas, and hydro) naturally provide inertia while operating. In contrast, inverter-based resources such as wind, solar PV, and battery storage do not inherently provide inertia, but can produce fast current injections that synthesizes inertial characteristics through advanced control technologies if required or incentivized.
- **Portfolio Level:** The aggregate inertia of the generation portfolio is a critical factor for grid stability. A portfolio with a high proportion of synchronous generation automatically provides significant inertia, whereas a portfolio heavily reliant on inverter-based resources may require additional grid support mechanisms (e.g., a fast frequency response from batteries, synthetic inertia, or synchronous condensers).

Voltage Support and Reactive Power: Voltage support refers to the ability of generation and non-generation resources to maintain voltage levels within acceptable limits across the grid by providing or absorbing reactive power.

- **Plant Level:** Synchronous generators are capable of supplying both active and reactive power, thus contributing to voltage support. Inverter-based resources can also provide reactive power; their effectiveness depends on the inverter technology used and application of control settings. All generators that are responsible for voltage and reactive power support must have an installed automatic voltage regulator (Brewer et al, 2019).
- **Portfolio Level:** A balanced portfolio will include resources capable of providing reactive power and voltage support across different locations on the grid. A strategy could include a mix of conventional generators, advanced inverter-based technologies, and dedicated reactive power compensation devices (e.g., capacitor banks and STATCOMs).

Black Start Capability: Black start capability refers to the ability of a generating unit to start up and restore electricity to the grid without relying on an external power supply, which is crucial for recovering from a complete blackout.

- **Plant Level:** Certain plants, such as hydropower, reciprocating engines, and some gas turbines, are designed with black start capabilities. These units can initiate the grid restoration processes after a disturbance resulting in an interruption. Coal-fired plants are generally not equipped for black start but

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2 Naming conventions and definition of reserve products might change from one grid or operating market to another. North American systems procure fast frequency response (FRR), primary frequency response (PFR), regulating and ramping reserves, and contingency reserves under variousi names, while Europe uses balancing reserve products that are named as follows from fastest to slowest: frequency containment reserve (FCR), automatic frequency restoration reserve (aFRR), manual frequency restoration reserve (mFRR), and replacement reserve (RR).

3 Inertia is the tendency of objects in motion to stay in motion and objects at rest to stay at rest, unless a force causes its speed or direction to change. It is one of the fundamental principles in classical physics and described by Isaac Newton in his first law of motion.

are often considered "next start" units that are cranked by a smaller black start unit and then utilized for grid reconstruction.[4]

- **Portfolio Level:** A reliable portfolio will include several black start-capable units distributed across different geographic regions to facilitate rapid and coordinated restoration of the power system following a blackout.

Energy Security and Fuel Supply: Energy security refers to the reliable supply of fuel to generation resources so they can operate as intended. This is particularly important for fossil fuel plants, which depend on a continuous supply of coal, natural gas, or oil.

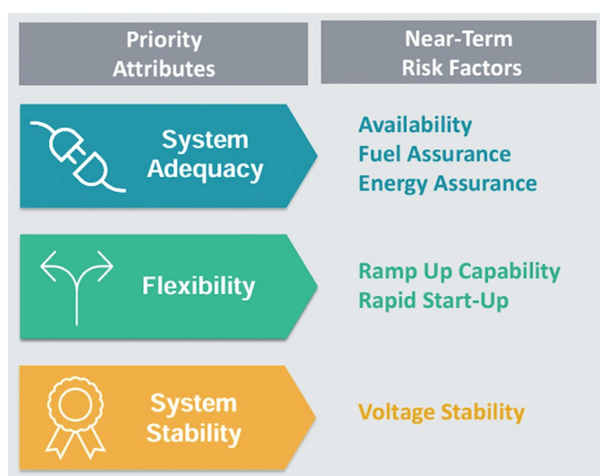
- **Plant Level:** The reliability of a plant's fuel supply chain affects its ability to operate consistently. Plants with on-site fuel storage[5] are generally considered more fuel secure than those relying on just-in-time fuel deliveries. Renewable resources are dependent on weather variability, but not fuel availability.
- **Portfolio Level:** A diverse generation portfolio often reduces the risk associated with fuel-supply disruptions. The inclusion of renewables and nuclear energy can enhance energy security by reducing dependence on delivered or piped fuels, improving resilience to supply chain issues. However, when a significant amount of renewables are deployed, renewable energy droughts must be considered and resources must be evaluated across larger areas to ensure replacement energy is available either internally or externally from neighbors during those periods.

State utility regulators continually monitor the challenges of maintaining a reliable electric system, particularly where there is rapid transformation of the energy mix. As the generation mix is becoming more diverse and extreme weather events are becoming more frequent and severe, the reliability of generation is changing. Data centers, industrial load growth, and electrification are poised to change traditional consumption patterns. These dynamics present significant challenges for grid operators.

A diverse array of resources is essential to fulfill all the required system attributes of a stable system, as no single resource can meet all needs. Historically, system requirements have been addressed by efficiently operating a varied fleet of resources. Resource adequacy is the responsibility of state regulators in vertically integrated states and of grid operators in competitive markets. These entities and their stakeholders must continue to work collaboratively to identify issues and chart paths forward.

Accordingly, in 2023, the Midcontinent Independent System Operator (MISO) designed and completed a foundational analysis of system reliability attributes (Midcontinent Independent System Operator, 2023). The

Figure 1: Priority Attributes and Near-Term Risk Factors (Midcontinent Independent System Operator, 2023)



4 For more discussion, see J.G. O'Brien, M. Cassiadoro, T. Becejac, G.B. Sheble, J. Follum, U. Agrawal, E. Andersen, M. Touhiduzzaman, and J. Dagle, *Electric Grid Blackstart: Trends, Challenges, and Opportunities,* Pacific Northwest National Laboratory, April 2022, www.pnnl.gov/main/publications/external/technical_reports/PNNL-32773.pdf.

5 Generators with fuel storage are those where measurable fuel inventories are located on or near to the plant so that transportation risks are minimized, examples include coal, nuclear, oil, hydro with pondage, and LNG. Just-in-time fuels are those that are consumed immediately upon delivery, examples include natural gas, run of river hydro, solar, and wind (North American Electric Reliability Corporation, 2024). One of the advantages of coal-based generation resources with respect to providing reliability services is the ability to store fuel on-site. However, coal supplies have tightened in recent years due to a confluence of factors, including contraction of the mining and transportation sectors and supply chain issues. Coal resources can also be affected by extreme winter weather freezing onsite coal piles and/or impacting coal-handling equipment.

analysis focused on three priority attributes as exhibited in **Figure 1**. The three priority attributes where risk to the system is most acute are as follows:

- **System Adequacy:** The ability of the generation fleet to serve load under all realistic modeled scenarios (up to relevant loss of load expectation [LOLE][6] or expected unserved energy [EUE] targets), including spiked or extended load or resource unavailability. As the fleet rapidly transforms with renewables, storage, and gas largely replacing retiring coal and other thermal generation, historical measures of needs and resource contributions are becoming less relevant. The intermittent and fuel-limited nature of the modern fleet raises concerns about energy assurance, particularly during multiday weather events, while reliance on natural gas for dispatchable capacity poses risks to fuel assurance, especially in extremely cold conditions.
- **Flexibility:** The extent to which a power system can modify electric production or consumption in response to changing system conditions. This includes the rapid start-up and ramp-up capabilities.
- **System stability:** The ability to maintain voltage stability under all operating conditions.

When comparing generation technologies with respect to reliability attributes, it is important to evaluate the performance of each technology across key metrics that are crucial for ensuring a reliable and resilient power grid. Having said that, conventional generation technologies, including coal, have advantages over intermittent renewable technologies in terms of providing dispatchable, reliable services to the system. However, new technologies, including advanced control systems and battery technologies, can narrow the gap in future energy grids by providing products such as virtual inertia, fast frequency response, and extracted wind kinetic energy.

Even though it may be premature to discuss the existence of fully mature and commercialized new technologies for inverter-based reliability services that can replace the role of conventional generation within appropriate regulatory and commercial frameworks, these technologies are expected to continue maturing in the coming years and will gradually increase their market penetration. It is also possible to update system operations to enable the integration of more intermittent resources through enhanced demand-side management and demand response mechanisms, utilization of synchronous condensers, and updating of under-frequency load-shedding settings. In the short term, however, it is critical to assess the current capabilities of these resources, current and near-term load growth, and the interaction between these forces to contribute to or challenge grid reliability.

Increasingly, grid operators and utilities are citing experience during normal and abnormal operating conditions in considering the availability of generation resources. Effective load carrying capability (ELCC) projects the contribution of a particular resource to meet resource adequacy needs. The ELCC metric conveys the percentage of a resource's nameplate capacity available to serve load during peak conditions (Graeter and Schwartz, 2020).

PJM Interconnection began calculating ELCC for fossil resources in addition to intermittent renewable resources for the 2026 / 2027 base residual auction (**Figure 2**). Coal

Figure 2: ELCC Class Ratings for the 2026/2027 Base Residual Auction
(PJM Interconnection, n.d.)

	2026/2027 BRA ELCC Class Ratings
Onshore Wind	41%
Offshore Wind	69%
Fixed-Tilt Solar	8%
Tracking Solar	11%
Landfill Intermittent	50%
Hydro Intermittent	38%
4-hr Storage	50%
6-hr Storage	58%
8-hr Storage	62%
10-hr Storage	72%
Demand Resource	69%
Nuclear	95%
Coal	83%
Gas Combined Cycle	74%
Gas Combustion Turbine	60%
Gas Combustion Turbine Dual Fuel	78%
Diesel Utility	91%
Steam	73%

6 Traditional supply adequacy to meet 1-in-10 LOLE (i.e., 1 day LOLE every 10 years).

has the third-highest ELCC at 83 percent, following nuclear and diesel units, reflecting the availability of coal stocks at generators in PJM's footprint. ELCC is used to accredit wind and solar resources in the Southwest Power Pool (SPP), MISO, the New York Independent System Operator (NYISO), PJM, and most of the Western Interconnection (Nethercutt, 2023 and Southwest Power Pool, 2024), but was not calculated for thermal resources in any other power grid. Instead, the vast majority of thermal resources have been considered 100 percent available to serve peak demand; however, experience with unexpected generator outages due to operational issues or fuel supply disruptions has demonstrated the shortcomings of that approach. The use of accurate, evidence-based accreditation methods aids planning for resource adequacy by ensuring adequate generation can perform at peak times.

Effective reliability regulation requires close collaboration between utilities, grid operators, and state regulators and might include changes in accreditation methods, business processes, investments in new technologies, and development of new standards or products to enhance, incentivize, or specifically require reliability attributes (e.g., mandatory requirements for attributes or new commercial flexibility products). Understanding and optimizing the reliability attributes at both the plant and portfolio levels are essential for maintaining a stable and secure power grid. As the energy landscape evolves, the importance of a well-balanced portfolio that can collectively satisfy these reliability attributes becomes even more critical.

III. Federal, Regional, State, and Private Entities Responsible for Grid Reliability

Grid reliability is shared among multiple entities. These organizations monitor different risks to reliability and have varying levels of authority to take or order regulated entities to take actions to mitigate risks to reliability. The five most important entities with responsibility over grid reliability are listed below:

- **NERC** (North American Electric Reliability Corporation) sets reliability standards and assesses the overall reliability of the North American grid. NERC has raised concerns about the potential reliability risks associated with the transition away from coal without adequate generation in place to support the grid.
- **Grid Operators** (e.g., RTOs/ISOs) monitor the reliability of the bulk power system and are responsible for maintaining a balance between supply and demand in real time. They assess the impact of coal retirements on grid reliability and plan for the integration of replacement resources.
- **Utilities** (especially vertically integrated utilities that build, own, and operate generation) are responsible for ensuring reliable service to their customers. They must consider the long-term implications of retiring coal plants, including the availability of replacement capacity.
- **State Utility Regulators** oversee utility operations within their jurisdictions, ensuring that any changes to the generation mix do not threaten reliability, affordability, or safety.
- **DOE** oversees funding opportunities and research and development initiatives to improve the reliability and security of the power grid.

Each entity views reliability through its specific lens, with grid operators focusing on real-time balancing, utilities on long-term resource adequacy, NERC on overall grid reliability, state utility regulators on ensuring that local electricity supply meets demand reliably and cost-effectively, and DOE on interstate and international reliability issues.

Authority of Each Entity to Act

If a threat to reliability is identified, each entity has different authorities:

- **NERC** can issue reports and recommend actions to address potential reliability risks with a national perspective and has authority (or delegates authority) to enforce reliability standards.
- **Grid Operators** can issue directives to maintain grid stability and sign "reliability must run" (RMR) agreements with individual power plant owners when necessary.
- **Utilities** may propose new investments or operational changes to regulators.
- **State Utility Regulators** continued operations of planned retiring plants, review and adjudicate utility decisions and can approve or deny actions to prioritize reliability, which could include delaying plant retirements in some states (see Section VII).
- **DOE** may exercise its authority under Federal Power Act section 202(c) to order grid operators and utilities to ensure that specified generators are available to operate.

In addition to DOE actions such as Federal Power Act 202(c) orders, actions from other federal agencies can have significant impacts on costs and reliability. As an example, the U.S. Environmental Protection Agency (EPA) issued a final rule in May 2024 establishing Greenhouse Gas (GHG) Standards and Guidelines for Power Plants (the "GHG Rule"). This rule was released concurrently with three other EPA regulations that impact fossil-fueled power generation.[7] Collectively, these four new regulations were projected to impose considerable financial and operational challenges on both new and existing coal-fired power facilities. Several grid operators, utilities, and state entities are engaged in litigation challenging these regulations. In March 2025, EPA Administrator Lee Zeldin announced the reconsideration of these rules and others impacting the energy industry (U.S. Environmental Protection Agency, March 2025). All entities responsible for ensuring grid reliability await the results of EPA's reconsideration though the specific outcomes and timing are unclear.

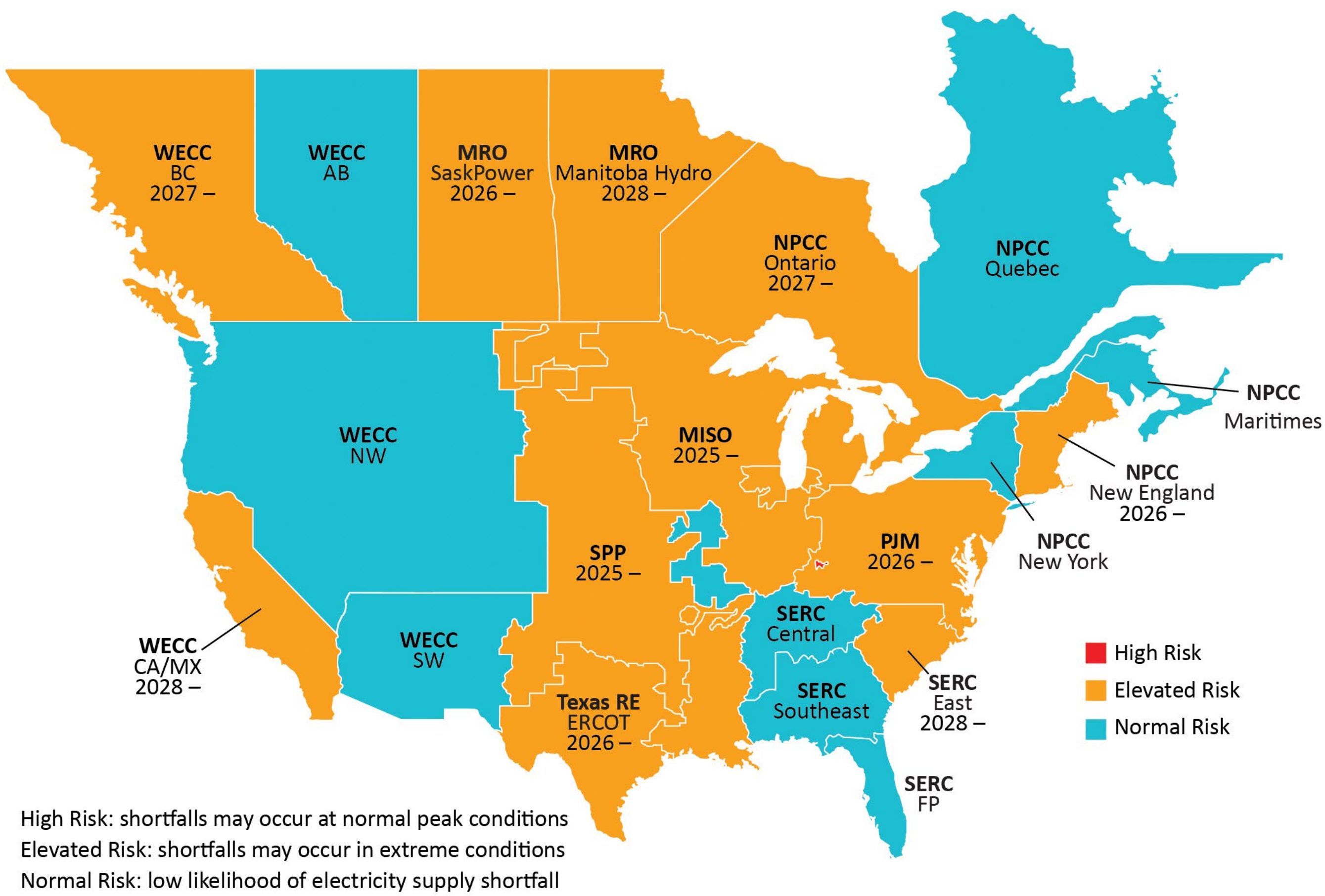
7 Mercury and Air Toxics Standards ("MATS") Final Rule, 89 Fed. Reg. 38,508 (May 7, 2024) (reducing the PM limit by a factor of 3 and imposing continuous emission monitoring requirements). Steam Electric Power Generating Effluent Limitation Guidelines ("ELG") Final Rule, 89 Fed. Reg. 40,198 (May 9, 2024) (establishing more stringent discharge standards for three wastewater streams generated at coal-fired power plants: flue gas desulfurization wastewater, bottom ash transport water, and combustion residual leachate). Coal Combustion Residuals ("CCR") Final Rule, 89 Fed. Reg. 38,950 (May 8, 2024) (requiring management of inactive coal ash surface impoundments located at inactive power plants and historical coal ash disposal areas).

IV. NERC's Assessment of Coal Retirements and Reliability in the 2024 Long-Term Reliability Assessment

As the entity charged with monitoring and evaluating North America's overall grid reliability, NERC conducts an annual long-term reliability assessment reporting on reliability, adequacy, and associated risks to the bulk power system based on projected electricity supply and demand, transmission system adequacy, and ongoing trends (North American Electric Reliability Corporation, n.d.). NERC's 2024 Long-Term Reliability Assessment highlights significant concerns about the reliability implications of the ongoing transition from coal to renewable energy sources in the U.S. electricity system, identifying multiple regions at elevated risk of electricity shortfalls in extreme conditions (**Figure 3**). NERC highlights the confirmed retirements of 79 gigawatts (GW) of fossil-fired and nuclear capacity by 2034, with an additional 38 GW of unconfirmed retirements (Figure 4). This shift, driven by environmental regulations and market dynamics, raises critical reliability risks, especially in areas with limited replacement capacity. NERC counts just 60 GW of dispatchable resources in the interconnection queue compared to 351 GW of variable (intermittent) resources (North American Electric Reliability Corporation, 2024).

NERC identifies in its assessment that the disorderly and accelerated retirement of synchronous and dispatchable plants (i.e., coal, natural gas, and nuclear generation), without adequate replacement by dispatchable resources or sufficient transmission development, could lead to electicity shortages, particularly during extreme weather events. The organization stresses the need for policies and regulations that consider grid reliability, advocating for a balanced approach that ensures reliable and resilient power supplies. NERC warns that without careful management, the early retirement of coal plants may jeopardize the stability of the U.S. electricity grid, leading to potential blackouts and increased vulnerability during peak demand periods (North American Electric Reliability Corporation, 2024).

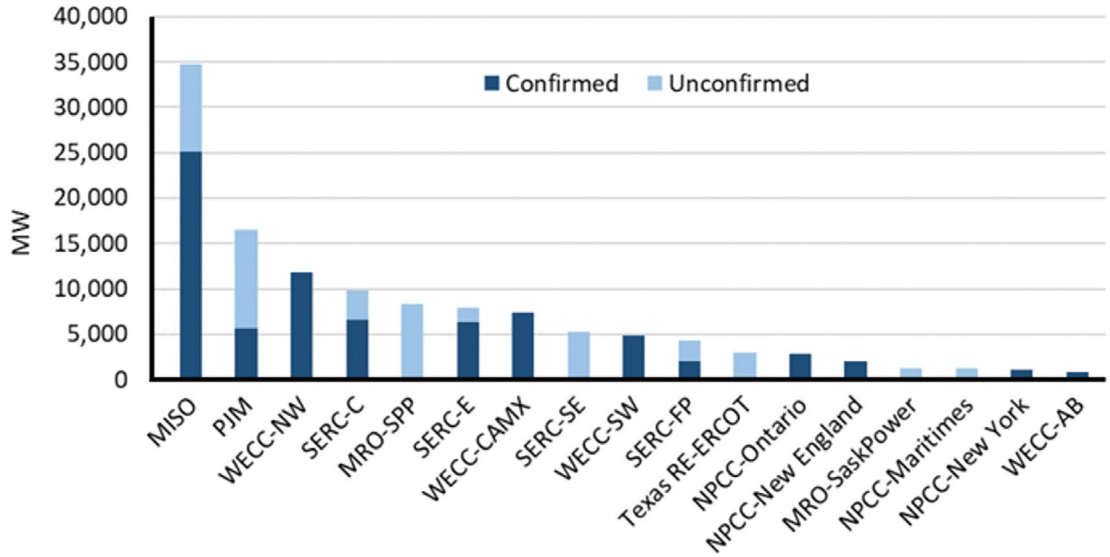
Figure 3: Risk Area Summary 2025–2029 (North American Electric Reliability Corporation, 2025)



Key Takeaways from NERC's 2024 Long-Term Reliability Assessment:

- Growing resource adequacy concerns are projected over the next decade, with capacity deficits anticipated in several regions. These shortfalls are primarily attributed to the retirement of older generators before suitable replacement resources can be brought online. This situation poses significant challenges for grid operators and policymakers in ensuring a stable and reliable electricity supply.

Figure 4: Projected Retiring Nuclear and Fossil Generation Capacity 2024–2034[8]
(North American Electric Reliability Corporation, 2024)



- Energy risks have been identified in various areas where the future resource mix may struggle to deliver sufficient electricity under energy-constrained conditions. Of particular concern are extreme weather events, which can place unprecedented stress on the power system. These risks highlight the need for a more resilient and adaptable grid infrastructure.

- Solar, battery, natural gas, wind, and hybrid generation systems are projected to be the primary additions to the resource mix (**Figure 5**) as older thermal generators are phased out. This shift towards renewable energy sources reflects both environmental concerns and technological advancements. However, it also presents new challenges in terms of grid integration and management of intermittent, inverter-based power sources.

- Electricity peak demand and load growth forecasts have recently been higher than at any point in the past decade (**Figure 6**). This surge is driven by various factors, particularly data center demand. The increasing adoption of electric vehicles, heat pumps, and other electric technologies in both the residential and industrial sectors has also contributed to this trend. This growth underscores the need for substantial investments in grid infrastructure and generation capacity.

8 Included in confirmed retirements in Figure 3 are generators that have reported plans to retire to MISO in the 2024 Organization of MISO States-MISO Survey. Many of these generators have yet to enter the MISO generator retirement process that triggers MISO to perform a reliability study that identifies transmission issues. See 2024 OMS-MISO Survey Results, June 20, 2024, https://cdn.misoenergy.org/OMS%20MISO%20Survey%20Results%20Workshop%20Presentation628355.pdf.

Figure 5: Planned Resources Projected Through 2034
(North American Electric Reliability Corporation, 2024)

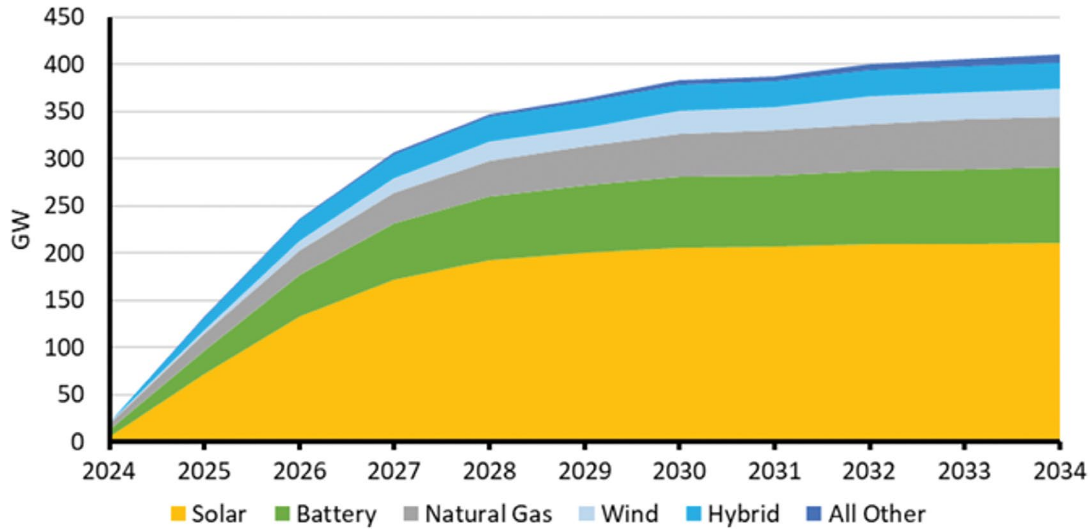
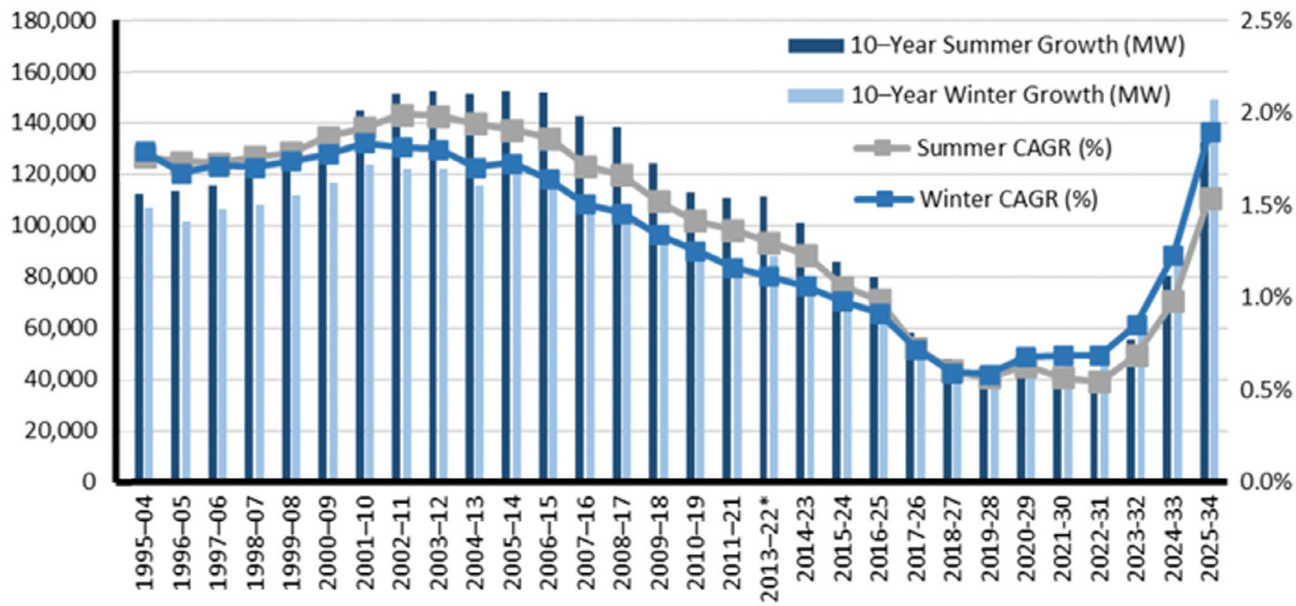
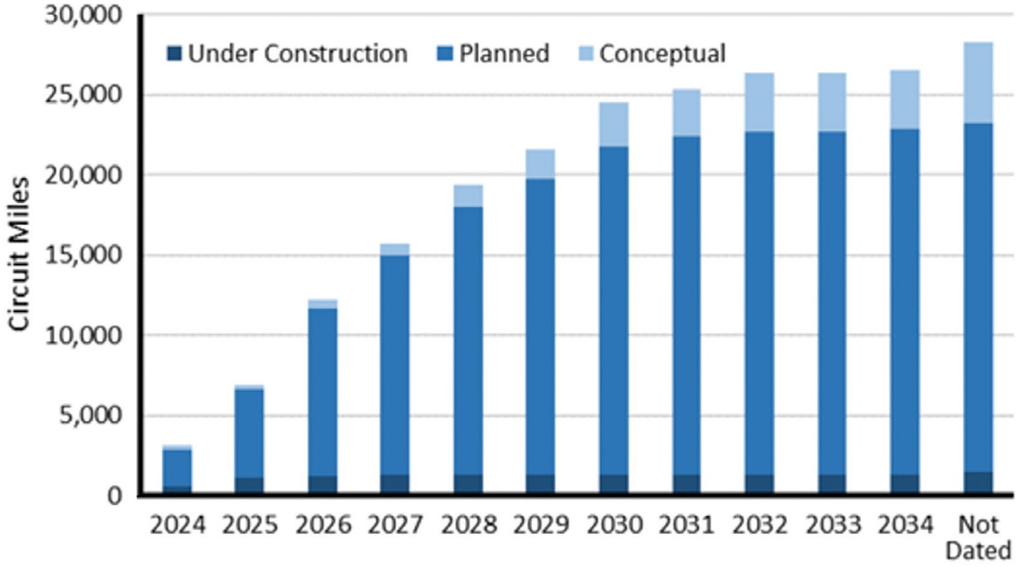


Figure 6: The 10-Year Summer and Winter Peak Demand Growth and Compound Annual Growth Rate (CAGR) Trends (North American Electric Reliability Corporation, 2024)



- While transmission development is increasing overall (**Figure 7**), the industry continues to face significant challenges in siting and permitting processes. These obstacles often lead to delays in critical infrastructure projects, potentially impacting the grid's ability to keep pace with the growing demand and changing generation patterns. Streamlining these processes, while balancing environmental and community concerns, remains a key challenge.

Figure 7: Future Transmission Circuit Miles >100 kV by Project Status
(North American Electric Reliability Corporation, 2024)



- The assessment provides several recommendations to address the identified challenges:
  - There is a pressing need to add new resources with essential reliability attributes, while simultaneously improving the dependability of existing resources. This dual approach aims to enhance overall system resilience.
  - Expanding transmission networks is crucial to accommodate the changing generation landscape and to ensure that power is efficiently distributed across regions.
  - Power systems are becoming increasingly complex, necessitating adaptations in their planning, operations, and market structures. These changes are essential for effectively managing an evolving grid.
  - Strengthening the relationships between reliability stakeholders and policymakers is vital. Enhanced collaboration can lead to more coherent and effective strategies for addressing grid challenges.
- The assessment raises concerns about performance issues related to inverter-based resources, such as solar PV and wind. Additionally, it highlights the risks associated with natural gas fuel supply during extreme weather events: "With electricity supplies coming increasingly from VERs and natural-gas-fired generators, there is a growing risk that supplies can fall short of demand during some periods" (North American Electric Reliability Corporation, 2024, p. 29). These issues underscore the importance of developing robust backup systems and diversifying energy sources to enhance grid resilience (North American Electric Reliability Corporation, 2024, p. 93).
- There is a recognized need for enhanced energy adequacy assessments and more comprehensive extreme weather scenario planning. As climate change increases the frequency and severity of extreme weather events, it becomes crucial to model and prepare for a wide range of potential scenarios to ensure grid stability under various conditions.
- NERC is undertaking ongoing initiatives to address the identified risks. These efforts include developing and updating reliability standards, creating guidelines for best practices, conducting detailed assessments of grid performance and vulnerabilities, and engaging with a wide range of stakeholders about challenges and solutions. These initiatives aim to proactively address emerging challenges and enhance the overall reliability and resilience of the power grid.

NERC's emphasis on the importance of dispatchable resources, like coal and natural gas, underscores their critical role in maintaining grid stability. Coal plants provide consistent, reliable power, especially during periods of high demand or low renewable generation, such as during extreme weather events. The potential for energy shortages in regions undergoing rapid coal retirements is an ongoing concern. NERC's assessment highlights that renewable energy sources, while essential for the energy transition, are not yet fully capable of providing the same level of reliability due to their intermittent nature and the need for enhanced power electronics to support reliability needs.

NERC calls for policies that balance policy goals with grid reliability. The organization recommends measures to extend the operation of essential coal plants until adequate replacements are in place, ensuring that the grid remains stable in coming years.

V. NERC's Recommendations for Enhancing Grid Reliability

NERC's recommendations to address potential reliability issues is multifaceted, focusing on adding new resources with reliability attributes, managing the pace of retirements (e.g., winterization of natural gas plants and production facilities, market enhancements to improve gas deliverability to generators), making existing resources more dependable, and improving planning and operational processes to enable earlier awareness of potential reliability risks and concerns. Each of these actions plays a crucial role in maintaining the resilience and reliability of the electricity grid, especially as it faces growing challenges from the energy transition, extreme weather events, and evolving demand patterns. The following section describes each of these actions in detail and explores potential steps to achieve them.

Adding New Resources with Reliability Attributes

Adding new resources with reliability attributes refers to integrating energy resources into the grid that can provide essential services, such as frequency regulation, voltage support, and ramping capabilities. These resources include not only traditional power plants but also advanced renewable energy technologies, energy storage systems, and demand response programs. State regulators will determine the technical and economic feasibility of these resources.

Potential Steps to Achieve This Outcome:

- **Incentivizing Investment in Reliable Resources:** To attract investment in resources with reliability attributes, policymakers and regulators could create market mechanisms that reward these attributes. This could include capacity markets, reliability payments, or enhanced compensation for ancillary services.
- **Promoting Technological Innovation:** Encouraging the development and deployment of advanced technologies, such as grid-forming inverters, high-capacity energy storage, advanced nuclear reactors, and fast-ramping gas turbines will be crucial should thermal retirements continue at a rapid pace. These technologies can provide stability to the grid, especially as the penetration of intermittent renewable energy sources like wind and solar increases. The affordability and commercial availability of these resources will be important to monitor.
- **Regulatory Reforms:** Updating grid codes and reliability standards to require new resources to have certain reliability characteristics would ensure that new additions contribute positively to grid stability. For example, renewable energy projects could be required to include storage or grid-supporting technologies in certain circumstances.[9] The significant use of natural gas for electricity generation and dependency to meet reliability requirements also raises questions about how natural gas infrastructure is developed and planned.

Managing Retirements Successfully

Managing retirements involves carefully planning and overseeing the decommissioning of older, less efficient, or polluting power plants, such as fossil and nuclear facilities. The goal is to ensure that these retirements do not compromise grid reliability by maintaining a balance between supply and demand.

Potential Steps to Achieve This Outcome:

- **Retirement Planning and Coordination:** Develop a strategic plan for retirements that coordinates the phasing out of old plants with the addition of new resources. This planning may consider regional differences, the availability of replacement capacity, and the time required to bring new resources online.

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9 For example, renewable energy projects could be required to include storage or grid-supporting technologies in certain circumstances. See North American Electric Reliability Corporation, "Quick Reference Guide: IBR Registration Initiative," July 2025, https://www.nerc.com/pa/Documents/IBR%20Registration%20Initiative_Quick%20Reference%20Guide.pdf.

- **Ensuring Replacement Capacity:** Before retiring a plant, it is essential to ensure that sufficient replacement capacity is available or will be available in a timely manner. This might involve fast-tracking the development of new generation, energy storage, and transmission resources, implementing temporary, rapidly deployable measures like demand response to bridge any gaps, or assessing the availability of transfer capacity from neighboring regions or jurisdictions.[10]

- **Environmental and Reliability Assessments:** Rulemaking agencies should conduct thorough environmental and reliability assessments to determine the impact of retirements. These assessments should inform the timing and sequence of retirements to avoid jeopardizing grid stability or environmental goals.

Making Existing Resources More Dependable

Making existing resources more dependable involves improving the performance, availability, and operational flexibility of the current generation and transmission fleet. This includes both traditional resources such as natural gas, coal, and nuclear, as well as renewable resources such as wind and solar.

Potential Steps to Achieve This Outcome:

- **Enhancing and Expanding Transmission Infrastructure:** New resources, especially renewables, often require enhanced transmission infrastructure[11] to deliver power where it is needed. To support increasing electricity demand, more capacity will be needed. However, because many States have restrictive policies on generation fuel choice, transmission will be needed to access reliable sources of energy from distant areas. Investment in robust transmission networks and grid-enhancing technologies (GETs) will enable the integration of geographically diverse resources, reduce the risk of localized disruptions, and provide options for system operators during extreme weather conditions that may limit the output of local resources.

- **Maintenance and Upgrades:** Investing in regular maintenance and necessary upgrades for existing power plants can significantly enhance their reliability. This includes modernizing control systems, improving fuel supply chains, and enhancing grid interconnections. Cold weather preparation, including required winterization of natural gas and electric system infrastructure could also make existing generation more dependable.

- **Enhanced Operational Practices:** Implementing advanced operational practices, such as predictive maintenance, real-time monitoring, and enhanced grid management software, can improve the responsiveness and resilience of existing resources.

- **Flexibility Enhancements:** Encouraging or requiring existing resources to become more flexible in their operations is crucial. This could involve retrofitting plants to allow for faster ramp-up and ramp-down times or improving the dispatchability of renewable resources through hybrid systems that include storage. Market enhancements could also be considered for ensuring natural gas infrastructure can support future electric system needs.

- **Incentivizing Resource Availability:** Introducing market signals that incentivize resources to be available during peak demand periods or critical reliability events is essential, particularly as large new loads driven by data centers and electrification come onto the system. Capacity payments or performance-based incentives can motivate plant operators to ensure their resources are online and ready when needed.

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10 For more discussion of interregional transmission capacity, see North American Electric Reliability Corporation, Interregional Transfer Capability Study, November 2024, https://www.nerc.com/pa/RAPA/Pages/ITCS.aspx.

11 NERC's resource-agnostic Transmission Planning (TPL) Standards require reliability planning regardless of generation types or locations, ensuring that the transmission system is robust enough to handle shifts in the generation mix. See North American Electric Reliability Corporation, n.d., "TPL-001-5.1 — Transmission System Planning Performance Requirements," https://www.nerc.com/pa/Stand/Reliability%20Standards/TPL-001-5.1.pdf.

- **Demand-Side Management:** Deliberately leveraging demand-side resources, such as energy efficiency programs, demand response, and DERs, can reduce the burden on existing generation and make the overall system more reliable, particularly during peak or ramping periods.

Each of these actions—adding new resources with reliability attributes, managing retirements, and making existing resources more dependable—is a critical piece of the puzzle in ensuring grid reliability in a rapidly evolving energy landscape. Achieving these goals will require coordinated efforts across various stakeholders, including federal and state regulators, grid operators, utilities, and the private sector. It will also necessitate significant investment, innovation, and a forward-thinking approach to electricity market design and operation. NERC's recommendations reflect the need for a holistic strategy that not only addresses immediate challenges but also builds a resilient and adaptable grid for the future.

VI. Regional and Federal Mechanisms for Delaying Generator Retirements

As explained in the previous sections, thermal power plants play an essential role in ensuring grid reliability, especially in light of the anticipated retirement of a significant portion of the coal fleet. This section explores the potential role of reliability-must-run (RMR) Agreements and DOE authority under Federal Power Act Section 202(c) in mitigating reliability challenges.

Reliability Must Run (RMR) Agreements

RMR Agreements, also referred to as System Support Resource (SSR) Agreements, are arrangements between RTOs/ISOs and generators which provide cost-based compensation to generators in exchange for delaying their retirement. These agreements are necessary when the grid is unable to replace a retiring generator's capacity in a timely manner, and their main purpose is to address temporary reliability issues, often caused by local transmission constraints. If no alternatives to maintain grid reliability can be found, the RTO requests the generator to continue operating under an RMR Agreement.

The agreements are usually short-term and subject to termination when the reliability issue has been resolved, typically after transmission upgrades are completed. These agreements are a "last resort," only used when no other cost-effective alternatives are available.

Regional Differences in RMR Agreements

The RMR processes differ across major regions in the United States (America's Power, 2022), and below is a non-exhaustive summary of these differences for some of the RTOs:

- **PJM Interconnection:** In PJM, generators notify the RTO of their planned deactivation up to six months prior, and PJM conducts reliability studies quarterly to assess if any of the notified deactivations could affect system reliability. PJM will notify the generator owner within 60 days after the quarter of the deactivation request if a reliability issue is found, including the impact and an estimated time for transmission upgrades. PJM is designing future analysis to include reliability safeguards.
    - Generators can still deactivate their facility after the notice period,
    - While PJM lacks a standard RMR Agreement, past agreements can serve as a model.
    - Generators can negotiate compensation with the PJM Market Monitoring Unit or file with the Federal Energy Regulatory Commission (FERC) to recover costs.
    - Negotiations won't delay payments to the generator, but the generator must refund any overpayments, with interest, if the final approved amount is lower than the filed amount to the FERC.
- **MISO:** MISO coordinates with utilities and states to refine generation resource plans to accelerate the addition of reliability attributes and moderate retirements to avoid undue reliability risk. MISO uses System Support Resource (SSR) Agreements, triggered by a generator's notice to retire. SSR Agreements provide cost-based compensation up to a unit's full cost of service. MISO is considering extending the required notice period for plant retirements from 26 weeks to 52 weeks, to improve the process. MISO will study if part or all of the resource's capacity is needed for system reliability in MISO 's footprint, potentially qualifying the generator for an SSR Agreement.
    - The standard term of an SSR Agreement is 12 months, with the possibility of extensions.
    - MISO can terminate an SSR Agreement with as little as 60 days' notice (shorter periods can be negotiated).
    - The SSR agreements between the resources and MISO are filed with FERC, and they specify the terms and conditions of the service, including the compensation to be provided to the resource for its continued operation.

  - A generator can file with FERC to seek additional compensation, including for capital improvements to meet environmental requirements.
  - The generator can rescind the notice to retire but then it has to cover the cost of MISO's studies.

- **SPP:** SPP lacks an RMR process, relying on a generator retirement process that focuses on only transmission upgrades and does not offer contracts for generators to postpone retirement. With SPP being comprised of vertically integrated utilities owning generation, transmission, and distribution assets, regional committees with participation from state utility regulators provide input into market design.

- **Electricity Reliability Council of Texas (ERCOT):** ERCOT has protocols for RMR service, triggered by a generator's Notice of Suspension of Operations. Notice is to be provided at least 150 days prior to any requested suspension date. ERCOT conducts public reviews and competitive alternatives before entering into an agreement. ERCOT will select the most cost-effective option between an RMR Agreement and other alternatives (Texas Administrative Code, 2022).
  - By filing a notice, the generator commits to closure, absent a finding of reliability need.
  - Generators cannot be forced to provide RMR service.
  - The agreement's term is generally limited to one year, but ERCOT may grant an exception if the generator needs to make a major capital investment for environmental compliance or to ensure availability.
  - The compensation is negotiated between ERCOT and the generator, based on the initial estimated budget submitted by the generator.

- **California ISO (CAISO):** CAISO Fifth Replacement Electronic Tariff (Section 41) sets the procurement rules for RMR resources as follows (California Independent System Operator Corporation, 2022):
  - The CAISO, subject to any existing power purchase contracts, has the right at any time based upon CAISO Controlled Grid technical analyses and studies to designate a Generating Unit or other resource as an RMR resource. CAISO also has the right at any time based upon CAISO-controlled grid technical analyses and studies to designate a resource for RMR service. A resource so designated shall then be obligated to provide the CAISO with its proposed rates for RMR service for negotiation with the CAISO.
  - If an owner of a generator plans to withdraw a generating unit from the CAISO markets, it must submit a formal written notice to the CAISO indicating its intent to retire or mothball the unit.
  - A pro forma RMR contract applicable to resources that receive RMR designations is developed as an annex to the electronic tariff.
  - RMR rates are authorized by FERC.

The Shortcomings of RMR Agreements in Addressing Reliability Risks Due to Coal Retirements

Even though the RMR Agreement protocols seem to provide a good mechanism to mitigate potential reliability risks due to the coal retirements, their current design also showcases the following shortcomings:

1. **Temporary Nature:** RMR Agreements do not address broader resource adequacy issues or declining reserve margins. They are a stopgap measure designed for transmission security problems.
2. **Limited Financial Incentives:** Generators may not find the financial terms attractive, as they are not compelled to enter RMR Agreements.
3. **Environmental Regulations:** RMR Agreements do not override environmental regulations, which can prevent a generator from continuing operations.
4. **Fuel Supply Uncertainty:** Generators may face difficulties securing fuel due to uncertainties about their operational demand under RMR Agreements.

5. **Market Distortion:** RMR Agreements, being outside the competitive market structure, can depress wholesale market prices and create distortions, potentially prompting other generators to seek financial support.

As a result, for RMR Agreements to be a viable alternative, procedural changes would be required to address drawbacks related to scale, duration, and market impact, which may or may not be achievable. Nonetheless, RMR Agreements can play a short-term role in maintaining grid reliability alongside a more comprehensive approach that includes technological innovation, market-driven solutions, and policy alignment.

The Department of Energy's Authority under Section 202(c)

The Department of Energy's (DOE) authority under section 202(c) of the Federal Power Act allows it to issue emergency orders to keep power plants operational when their closure could jeopardize grid reliability (U.S. Department of Energy, n.d.) This provision is typically invoked during national emergencies, extreme weather events, or significant grid stress situations and has been exercised five times so far in 2025. The DOE can mandate a plant to continue operations, even if it is scheduled for deactivation or retirement, if it is deemed essential to maintain grid reliability.

In practice, DOE has exercised this authority several times, such as during heatwaves or extreme cold events, requiring certain plants to exceed environmental limits or remain operational past their planned shutdown dates (U.S. Department of Energy, n.d.). Similar to RMR Agreements, the section 202(c) mechanism is considered a critical, short-term solution to prevent grid failures while longer-term reliability measures, like transmission upgrades or new generation, are implemented. Nevertheless, both section 202(c) and RMR Agreements can serve as safety valves for reliability.

VII. State Legislative Interventions to Delay or Suspend Coal Retirements

Several states are either proposing or have already enacted legislation that would allow them to intervene in the retirement of coal plants for reliability reasons. Summaries are provided below. These efforts aim to support coal plants facing closure due to the rise of environmentally dispatched renewable energy and the prospect of stricter federal pollution regulations (Plautz and Tomich, 2024).

Similar legislative efforts are underway in other states, such as Alaska and Wyoming, where proposals aim to extend the life of coal plants by loosening environmental restrictions. In Kansas, a recent bill would allow utilities to charge customers for maintaining coal plants, even if they operate infrequently, and make it harder to close them for non-economic reasons (Cooper, 2024).

Supporters argue that preserving coal plants is crucial for maintaining reliable power, especially as the demand for electricity increases. Opponents dispute this point or argue that other generation resources can more cost-effectively serve growing load.

These bills typically grant state regulators more authority over coal plant retirements and bring conditions that make it either harder to retire or improve the economics of the coal plants. For example, Utah SB 161 allows the state to buy coal plants using public funds (Cabrera, 2024) to keep them operational.

Proponents of these bills emphasize the need for reliable electricity sources amid rising demand, while critics argue that the focus should be on transitioning to more environmentally sustainable and cost-effective energy solutions.

Recent State Legislation Enacted to Delay or Suspend Coal Retirements

- **Arkansas: House Bill 1665 (2021):** The "Affordable Energy Act" requires the Public Service Commission to evaluate the remaining useful life of electric generation units and determine whether a life extension is consistent with the public interest. The PSC is charged with analyzing costs and benefits, rate impacts, and reliability and resilience every three years (Arkansas State Legislature, 2021). HB 1665 was amended with SB 536 in April 2023 to require the PSC to issue a report on the remaining useful lives of existing generation units with announced retirement dates (Arkansas State Legislature, 2021b).

- **Indiana: House Bill 1414 (2020):** This bill aims to slow the retirement of coal plants by requiring utilities to obtain approval from the Indiana Utility Regulatory Commission before shutting down any coal-fired power plants. The bill emphasizes the need to maintain reliability and ensure that any plant closures would not negatively impact the stability of the grid (Indiana General Assembly, 2020). The legislation reflects concerns over job losses and the potential economic impacts on coal-dependent communities, as well as the need to maintain a reliable energy supply.

- **Kansas: State Bill 455 (2024):** In Kansas, lawmakers have been actively considering legislation that would require thorough assessments of the impact on grid reliability and the economy before allowing coal plant retirements. SB 455 involves a collaboration between Evergy, the state's largest coal plant operator, and the Kansas Chamber of Commerce. The statute adds requirements that must be met to close coal plants by requiring utilities to maintain operations of infrequently used coal plants, with the ability to pass on costs to customers (Kansas Legislature, 2023). The statute mandates that before a coal plant is retired, utilities must replace its capacity with reliable alternatives, ensuring no negative impact on the state's electricity grid or economy (Plautz and Tomich, 2024).

- **Kentucky: Senate Bill 4 (2023):** This statute creates a presumption against the retirement of coal plants by requiring utilities to prove that such retirements won't compromise grid reliability. It also mandates that any new generation must be dispatchable, emphasizing the importance of maintaining a stable and reliable energy supply (Kentucky Legislature, 2023). Senate Bill 349 created the Energy Planning and Inventory Commission (EPIC) and requires any utility seeking to retire any existing coal, oil, or natural gas-fired electric generating plant to give notice to EPIC no later than 180 days before submitting a retirement application to the Public Service Commission (PSC). The law requires that the PSC find, in order to overcome the rebuttable presumption against the retirement, that a utility seeking to retire an electric generating unit will replace it with new electric generating capacity that has the same or higher capacity value and net capability, unless the utility can demonstrate that it is not necessary; requires that the PSC find, in order to overcome the rebuttable presumption against the retirement, that the retirement will not commence until the replacement generating capacity is fully constructed, permitted, and in operation, unless the utility can demonstrate that it is necessary to commence the retirement earlier (Kentucky Legislature, 2024).

- **Missouri: House Bill 2485 (2022):** Missouri's legislation requires that utilities must conduct a comprehensive reliability assessment before retiring any coal-fired generation. The bill also grants the Missouri Public Service Commission the authority to delay plant retirements if it determines that doing so is necessary to maintain grid reliability (Missouri House of Representatives, 2022). This legislation was driven by concerns about the increasing reliance on natural gas and renewables, and the need to ensure that the grid remains resilient, especially during extreme weather events.
- **Montana: House Bill 476 (2021):** This bill allows the Montana Public Service Commission to delay the retirement of coal plants if it determines that the closure would threaten grid reliability or result in higher energy costs for consumers. The legislation also includes provisions for evaluating the impact of plant closures on local communities and the economy (Montana Legislative Services Division, 2021). Montana's coal industry plays a significant role in the state's economy, and this bill reflects the desire to balance environmental concerns with economic and reliability considerations.
- **Utah: Senate Bill 161 (2024):** This bill extends the life of coal-fired generation units at the Intermountain Power Plant (IPP) near Delta, Utah, which were set to retire by July 2025. The bill allows Utah to potentially purchase these coal generators if no third-party buyer is found, thereby keeping the facility operational (Utah State Legislature, 2024). Proponents argue that the bill supports energy security by maintaining dispatchable energy resources, but it has sparked significant debate due to environmental concerns and the potential for conflict with federal regulations such as the Clean Air Act. The Intermountain Power Agency (IPA), which owns the plant, opposed the bill, warning that it could interfere with their plans to transition the plant to natural gas and renewable energy sources (known as "IPP Renewed"). IPA has already committed significant resources to this transition, and keeping the coal units open could jeopardize these investments. Furthermore, non-compliance with environmental commitments might trigger legal challenges from the EPA, potentially leading to earlier shutdowns or increased oversight of other Utah industries.
- **West Virginia: Senate Bill 542 (2021):** This bill mandates that utilities must demonstrate that retiring a coal plant will not compromise grid reliability or result in higher costs for consumers. It also requires that any replacement generation be capable of providing the same level of reliability services as the retiring coal plant (West Virginia Legislature, 2021). The bill is part of a broader effort in West Virginia to protect its coal industry and the jobs associated with it, while also addressing the state's energy security.
- **Wyoming: Senate File (SF) 159 (2019):** Known as the "Coal Plant Closure Bill," this legislation requires utilities to make a good faith effort to sell coal plants slated for retirement before they can be closed (Wyoming Legislature, 2019). The intent is to keep these plants operational under new ownership, preserving jobs and ensuring that the coal fleet continues to contribute to grid reliability. The bill reflects Wyoming's commitment to its coal industry and its vital role in the state's economy, while also addressing concerns about the reliability of the electricity grid. In 2021, House Bill 166 created a rebuttable presumption against the retirement of coal or gas generation unless the utility demonstrates cost savings to the rate payers and

that there will be sufficient reliability power and no adverse effect on reliability (Wyoming Legislature, 2021). In 2024, Wyoming enacted SF0022, which authorized the Public Service Commission to establish baseline reliability standards for public utilities with penalties for noncompliance (Wyoming Legislature, 2024a), and SF0042, which requires public utility owners of coal-fired generation in Wyoming to evaluate carbon capture for coal so that the PSC can establish standards for low-carbon and dispatchable and reliable energy to maintain reliability and also requires the PSC to establish baseline reliability standards to ensure that the expansion of intermittent generation does not diminish power quality or increase momentary outages (Wyoming Legislature, 2024b).

These examples highlight a trend among state policymakers to delay or suspend the retirement of existing generating units. While the specifics of each bill and authority granted to state utility regulators vary, the underlying concern is consistent: ensuring that retiring resources do not compromise grid stability or lead to economic hardships for communities reliant on resource extraction, power generation, and related industries.

VIII. Considerations for State Utility Regulators

State utility regulators have consequential roles in the complex task of maintaining grid reliability, safety, and affordability while meeting state policy goals during a challenging period for the power system. Topics that will be important to monitor on an ongoing basis include:

Reliability Attributes

Understand the critical reliability attributes provided by coal plants, such as resource adequacy, inertia, frequency response, voltage support, and economic dispatch, as well as the reliability performance of other resources. As the generation mix changes, regulators must ensure utilities are maintaining these attributes through incoming resources, technologies, or a diverse mix of generation to ensure all reliability attributes are adequately covered at the portfolio level.

- **Market Reforms:** Consider market reforms that properly value and compensate all resources for essential reliability services to ensure a reliable grid in a changing energy landscape.

Technology and Infrastructure Considerations

As the energy landscape evolves, utility regulators consistently navigate the intersection of legacy infrastructure and cutting-edge solutions. This tension entails not only keeping abreast of technological developments but also encouraging the thoughtful integration of these technologies into the existing grid infrastructure through comprehensive bulk power system planning.

- **Emerging Technologies:** Stay informed about advancements in technologies that can provide reliability services, such as battery storage, advanced inverters, and synthetic inertia. It is important for regulators to receive accurate information about the commercialization of these technologies in order to make investment decisions more consistent with the public interest.

Regulatory and Policy Changes

As the energy sector undergoes significant changes, regulators are tasked with implementing and adapting policies that support a stable transition while meeting environmental and state policy goals.

- **Environmental Regulations:** Carefully assess the impact of federal and state environmental regulations on coal plant operations and potential retirements. Consider how compliance requirements may affect the economic viability of existing coal plants and the ultimate impact on consumers' utility and tax bills.

- **Reliability Safeguards:** Explore regulatory mechanisms to preserve critical coal units for reliability purposes, such as creating special categories for reliability-essential units or implementing flexible compliance schedules. Policymakers may need to provide utility and environmental regulators with additional statutory authority to consider new actions to preserve reliability.

Economic Considerations

Economic tools and methods to enable assessments of the impact of changes to the grid and can guide market reforms.

- **Cost Analysis:** Evaluate the full economic impact of coal plant retirements, including potential generation replacement costs, new and upgraded transmission, and reliability services.

Planning and Risk Management

Navigating the evolving energy landscape requires a proactive approach to planning and risk management, ensuring that environmental objectives are balanced with grid reliability and affordability.

- **Long-term Planning:** Ensure development of comprehensive long-term plans that address both environmental goals and reliability needs, considering various scenarios of coal plant retirements and replacement resources. State policy considerations and affordability will be essential inputs for state utility regulators as well.

- **Risk Assessment:** Conduct thorough risk assessments of potential reliability impacts from accelerated coal plant retirements, especially in regions heavily reliant on coal generation. By carefully considering these factors, state utility regulators can work towards maintaining a reliable and resilient grid while supporting the transition to cleaner energy sources. Collaboration with grid operators, utilities, and other stakeholders will be crucial in navigating this complex landscape.

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1101 Vermont Ave, NW • Suite 401 • Washington, DC 20005
www.naruc.org • (202) 898-2200