

## Natural Gas and Electricity Interdependence

*Approved by IEEE-USA  
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The reliability of the U.S. electrical power supply is inextricably linked with the security and resilience of the natural gas system. Natural gas-fired power generation is the nation's single largest source of electricity, and this interdependency is particularly critical during extreme weather and peak demand. The natural gas and electric sectors are subject to separate regulatory frameworks and operational protocols, yet their integration is essential for grid stability and reliability. Disruptions in one system can and have caused cascading failures in the other, posing significant risks to energy security and public safety.

The increasing reliance on natural gas for electricity generation introduces several key vulnerabilities, including:

- **Operational and Scheduling Mismatches:** Gas consumption typically peaks at night, while electricity consumption peaks in the midday to early evening. This misalignment between the "gas day" and "electric day" can complicate fuel procurement. This is particularly an issue for gas plants operating on non-firm, or interruptible, transportation contracts. Natural Gas contracts prioritize pipeline capacity for firm customers—such as local distribution companies (LDCs) that serve natural gas-heating needs during periods of high gas demand or emergencies.
- **Infrastructure Co-dependencies:** The physical co-dependence of natural gas and electricity systems creates significant vulnerabilities. Gas compressor stations and wellheads, which are critical to maintaining pipeline pressure and supply, can be powered by grid electricity. The transition from fossil-fuel to electric-powered compressors at compressor stations on major gas pipelines can be a vulnerability if backup fossil-fuel compressors are not maintained. The loss of a single compressor station, or of a series of them, can occur due to physical damage, weather-related outages, or a cyberattack on either gas equipment itself or grid infrastructure. It can severely restrict gas flow to power plants, potentially leading to widespread power outages. The loss of electric power can also cause

gas infrastructure to cease functioning, leading to circular dependencies. Studies have shown that the loss of a single gas compressor station can cause a generation outage larger than the loss of the largest generator in certain systems<sup>1</sup>. There are 1,400 gas pipeline compressor stations across the U.S., with a combined compression capacity of 21,000,000 HP (16 GW).

- **Gas Pipeline and Storage Infrastructure Capacity:** Currently, US natural gas usage is split approximately 45% for the electric power sector, 30% for the industrial sector, and 25% for residential and commercial use. Industries use natural gas for process heat, combined heat/power, and as feedstock. Residential and commercial usage goes to heating homes/businesses, vehicle fuel, and exports. The total installed natural gas-powered electric generating capacity in the U.S. is near 520 GW, representing roughly 40% of the nation's total electric capacity. 12GW of new Combined Cycle Gas Turbine (CCGT) electric generation capacity entered service in 2022-2023. Developers are planning to add 20 GW more to service by 2028. Faster-ramping simple-cycle units (SCGTs) for enhanced grid stability are also coming online. Information above is based on data from the US Energy Information Association (DOE-EIA).<sup>2</sup>
- **Load Shedding Plans:** A crucial yet often overlooked vulnerability is the inclusion of critical gas infrastructure in electric system load-shedding plans. During grid emergencies, power curtailments to gas facilities are common, leading to gas supply disruptions that exacerbate the electric system emergency and create a dangerous feedback loop.
- **Gas System Vulnerabilities and Emergency Gas Prioritization:** In the United States, winter storms, such as Winter Storm Uri, have caused gas wellheads to freeze, while available gas was prioritized for community needs. This led to a gas shortage for power plants, causing widespread outages. Gas transmission is also vulnerable to extreme winter weather, which can lead to shortages. Transporting natural gas from production sites to power plants is a critical component of the system. The U.S. pipeline network, while extensive, may not have the capacity to meet the growing demands of gas-fired power generation, especially during peak periods. The North American Electric Reliability Corporation (NERC), numerous Regional Transmission Organizations (RTOs) and Independent System Operators (ISOs), and power pools have raised concerns about the adequacy of winter gas supplies and the potential grid impacts of shortages. This highlights that, while natural gas production has increased, the transportation and delivery system may struggle to keep pace with demand. The security of this delivery

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<sup>1</sup> <https://www.sciencedirect.com/science/article/pii/S1040619023000180> “How Vulnerable are US Natural Gas Pipelines to Electric Outages?” by Sean Smillie, M. Granger Morgan, Jay Apt-The Electricity Journal, V36, I2-3, March-April, 2023.

<sup>2</sup> “FERC-NERC-Regional Entity Joint Blackstart and Next-Start Resource Availability Study in the Texas Interconnection”, Federal Energy Regulatory Commission, et al ... December 19, 2023

system directly affects the reliability of the electric grid. The pipeline network—with its myriad components, such as compressor stations, valves, and metering stations—is susceptible to both physical and cyber threats. These are acute, pressing vulnerabilities; the Department of Homeland Security (DHS) and the Department of Transportation (DOT) have issued guidelines to enhance the physical and cyber security of pipeline systems. These measures include securing critical infrastructure from physical damage, implementing access controls, and bolstering cybersecurity defenses to prevent remote attacks that could manipulate flow rates, trigger shutdowns, or compromise operational data.

### **Recommendations:**

Toward these goals, IEEE-USA recommends that the appropriate U.S. regulators and entities undertake the following actions:

- **Consolidation of Oversight and Standards of Gas System:** We recommend a strategic consolidation and expansion of regulatory authority to create a unified body responsible for gas energy reliability. This would involve integrating the gas-related regulatory and safety responsibilities of the Transportation Security Administration (TSA) and DOT- PHMSA into the jurisdiction of the Federal Energy Regulatory Commission (FERC). This newly consolidated framework under FERC would empower it to designate NERC as the entity responsible for setting and enforcing mandatory, legally binding gas reliability standards, reflecting its broader scope.
- **Enhanced Gas-Electric Coordination and Infrastructure Resilience:** Regulators must mandate increased visibility for electric grid operators (e.g., RTOs/ISOs) into real-time gas system conditions (including pipeline flows, pressure, and operational alerts) to enable them to anticipate and mitigate potential fuel shortages; this effort must be coupled with a comprehensive, mandated assessment and hardening of critical gas infrastructure to ensure it is weatherized and protected against physical and cyber threats; Implementing comprehensive permitting reform to accelerate the approval and construction of necessary new energy infrastructure (transmission, pipelines, storage, and generation) that is essential for both systems to maintain reliable service and meet growing demand
- **Establish Robust Coordination Mechanisms Within the Natural Gas Supply Chain:** Formalize and strengthen coordination among electric power producers that use natural gas, the entities that supply it (including interstate and intrastate pipelines), and local gas distribution companies. Increase off-site and local natural gas storage to better balance seasonal and emergency demand. Provide regulatory approval to override natural gas transportation contracts that limit gas supply to generation facilities during defined system emergencies.

- **Include Gas Risk Assessments in Electric System Planning:** Establish NERC standards for electric system planning that require transmission planners, reliability coordinators, and balancing authorities to conduct studies assessing the impact of gas infrastructure loss on electric system reliability.
- **Strengthen Joint Security Coordination:** Bolster coordination between gas and electrical systems and the entities with jurisdiction for physical and/or cyber security, including FERC, the U.S. Department of Transportation (DOT), the U.S. Department of Homeland Security (DHS), the Federal Emergency Management Agency (FEMA), and other cognizant state and/or local entities.
- **Gas Contracts for Generation:** For generators of last resort, such as blackstart and next-start generators, grid operators should require that they have firm gas contracts and develop market mechanisms to compensate them for this. Contractual arrangements must also be designed to permit the reallocation of natural gas to critical power generators during electric system emergencies to prevent cascading failures.

*The IEEE-USA Energy Policy Committee developed this statement, representing the considered judgment of a group of U.S. IEEE members with expertise in the subject field. IEEE-USA advances the public good and promotes the careers and public policy interests of the nearly 160,000 engineering, computing, and allied professionals who are U.S. members of the IEEE. The positions taken by IEEE-USA do not necessarily reflect the views of IEEE or its other organizations.*