

Energy Infrastructure and the Defense Industrial Base

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THE ISSUE

Can the energy infrastructure serving the U.S. defense industrial base sustain production under mobilization? This paper focuses on three scenarios for mobilization consistent with baseline production, defense buildup, and peer war. Using embodied energy methods, the research team estimates that war production rates would require 17.4 petajoules (PJ) of energy annually, a relatively small amount nationally, but one that would need to be concentrated at facilities in already stressed grid regions. Facilities for the defense-critical production of steel, aluminum, titanium, and semiconductors are clustered in regions already facing eroding reserve margins and surging data center demands. Natural gas deliverability constraints compound these risks, as key facilities depend on gas both as direct fuel and as the primary source of regional electricity generation. This paper recommends extending defense-critical electric infrastructure designations to industrial nodes, creating dedicated permitting and finance pathways to facilitate energy production, and integrating energy resilience into supply chain risk assessments.

INTRODUCTION

Energy shortages constrained wartime production during World War I, with power shortfalls resulting in chemical, steel, and metallurgy plants across the Northeast producing below capacity. The U.S. government learned from this experience: Before World War II, it surveyed national power capacity, controlled power plant siting to align supply with wartime demand, mandated interconnected “power pools,” and combined industry and military engineering prowess to improvise solutions at on-site facilities. These interventions prevented energy shortages from stalling wartime production during the war despite a **68 percent** increase in electricity demand between 1939 and 1945.

The fact that government intervention was needed to prevent energy shortfalls from affecting defense production during World War II suggests that the United States should

be attentive to how it provides energy to strategic industries. The 2025 **National Security Strategy** (NSS) prioritizes both the U.S. defense industrial base and U.S. “energy dominance” but does not clearly link the two, as history suggests it should. This paper represents a first effort to demonstrate how energy supply and defense production are linked in practice and where the United States faces the greatest risks.

DEFINING MOBILIZATION

To assess the energy implications of a military buildup, the team generated three scenarios for defense production. The **baseline** scenario assumes small increases over current rates of production; the **buildup** scenario assumes increases in production that permit U.S. services to meet their stated force structure goals or, if no stated goals were available, what policy analysts believe would represent

ambitious but achievable goals. The **war rate** scenario assumes a total mobilization of U.S. society to fight a protracted war in the Indo-Pacific over a period of roughly five years. This final scenario was based on a combination of publicly reported estimates of loss rates from wargames and extrapolation from U.S. production mobilization during World War II.

Table 1: Select Annual Defense Production Levels by Scenario

	Baseline (units)	Buildup (units)	War Rate (units)
Munitions	4,255	12,500	97,315
Unmanned Systems	129	315	1,600
Naval Systems	4.45	10.25	15.83
Combat Aircraft	200	320	636
Bombers	7	20	40

Source: CSIS.

Notably, each production category is made up of various individual weapons systems. For example, “munitions” comprises the GBU-39 Small Diameter Bomb, Joint Air-to-Surface Standoff Missile (JASSM), and the Tomahawk Land Attack Missile. The full breakdown of each category is available in this paper’s methodological annex.

The **buildup** and **war rate** scenarios assume that the United States can alleviate other structural obstacles to increased military production. Several experts interviewed for this project argued that budgetary pressures, for example, were likely to constrain the military’s ability to increase production well before any sort of energy limitation came into play. Multiple analysts have persuasively argued that a U.S. mobilization for war with China will come nowhere near that of the U.S. mobilization for World War II. The team decided to use the World War II analogy despite this argument because the mobilization level before World War II represents the most demanding scenario for the U.S. energy supply.

The research team drew on information from expert interviews, public statements by U.S. government personnel and defense industry members, government documents, and think tank reports to construct each scenario. CSIS also conducted two workshops under the Chatham House Rule to pressure-test and validate the scenarios.

A complete description of scenarios and methods is included in the annex.

DEFENSE PRODUCTION ENERGY NEEDS

The research team took an embodied energy approach to establish energy demand estimates across scenarios. This method breaks down major weapons systems into their primary material constituents, estimates the embodied energy of each system using published values for energy intensity by material, and maps that demand to production facilities (fabs) where those materials are manufactured in the United States as of 2025.

Embodied energy, measured in megajoules per kilogram (MJ/kg), represents the cumulative energy input required to produce a material from raw resource extraction through final manufacturing, including energy from gas, coal, electricity, and other sources.

Key material categories analyzed include:

- **Metals:** Steel (25.3 MJ/kg), aluminum (155 MJ/kg), and titanium (361 MJ/kg)
- **Composites:** Carbon fiber (286 MJ/kg), graphite epoxy (203 MJ/kg), and fiberglass epoxy (44.7 MJ/kg)
- **Electronics:** Printed circuit board (PCB)-intensive components (748.8 MJ/kg)
- **Energetics:** Explosives and solid rocket propellants

To translate these material-level energy intensities into system-level estimates, the team broke down each weapons system into its primary material constituents by weight, drawing on publicly available technical specifications, manufacturer disclosures, and expert interviews. For example, an F-35A stealth fighter jet was broken down into its approximate masses of titanium, aluminum, carbon fiber composite, and electronics components, each of which carries a distinct embodied energy value. Multiplying the mass of each material by its energy intensity yields an embodied energy estimate per unit. Multiplying that energy estimate by the production volumes defined in each scenario yields total energy demand by system, material, and scenario. This approach allows the identification not only of how much energy mobilization is required in aggregate, but also which materials drive that demand and, consequently, which production facilities and regional grids face the greatest pressure.

The study assumes that these methods are biased downward because calculations rely on open-source data using civilian, rather than military-grade, values for embodied energy. Moreover, the scenarios encompass only a subset

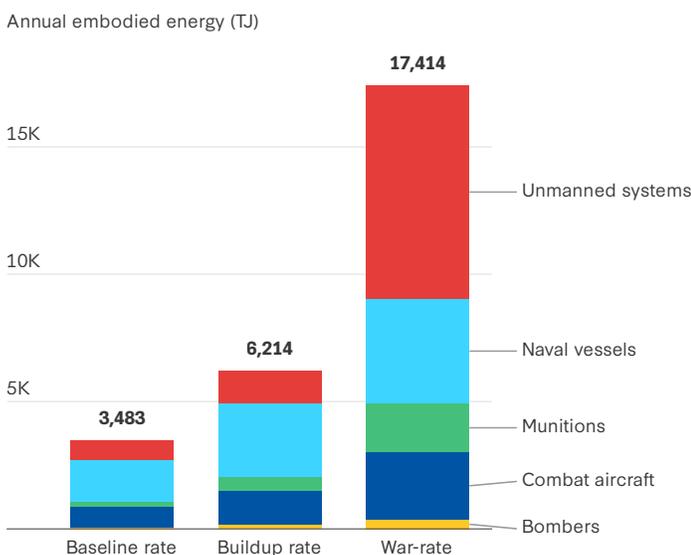
of the weapons systems necessary for military mobilization and, furthermore, exclude assembly and production energy needs. However, by focusing on key primary inputs and their embodied energy, the study team believes that it is possible to capture the bulk of energy demand and to identify regional risks for production scale-up without needing to trace defense supply chains through nearly 200,000 suppliers. (For a more detailed discussion of the methodology, system decomposition, and production-rate assumptions, including the methodological limitations, see the annex.)

MOBILIZATION ENERGY DEMAND

The war rate scenario represents 17.4 PJ of annual manufacturing energy demand. Increased munitions and unmanned systems production account for approximately 60 percent of this demand, while combat aircraft and naval vessels account for 15 and 24 percent, respectively. For context, 17.4 PJ is relatively small when compared to state- and national-level energy use—for example, as of 2023, Maine’s annual energy consumption was **350 PJ**, Mississippi’s was **1,100 PJ**, and total U.S. energy use was **99,000 PJ**, nearly 5,700 times larger.

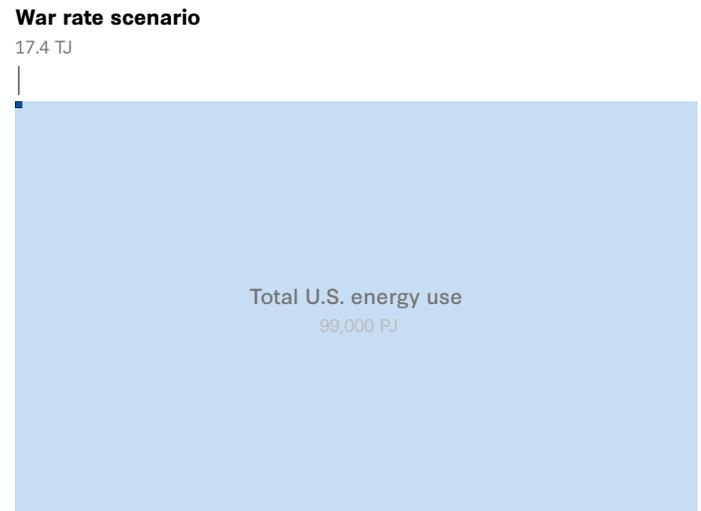
At the national level, defense industrial base (DIB) energy demand is unlikely to be a binding constraint regardless of mobilization scenario—the United States, in

Figure 1A: Estimated Annual Embodied Energy by Defense System



Source: CSIS.

Figure 1B: Estimated Annual Embodied Energy vs. Total U.S. Energy Use



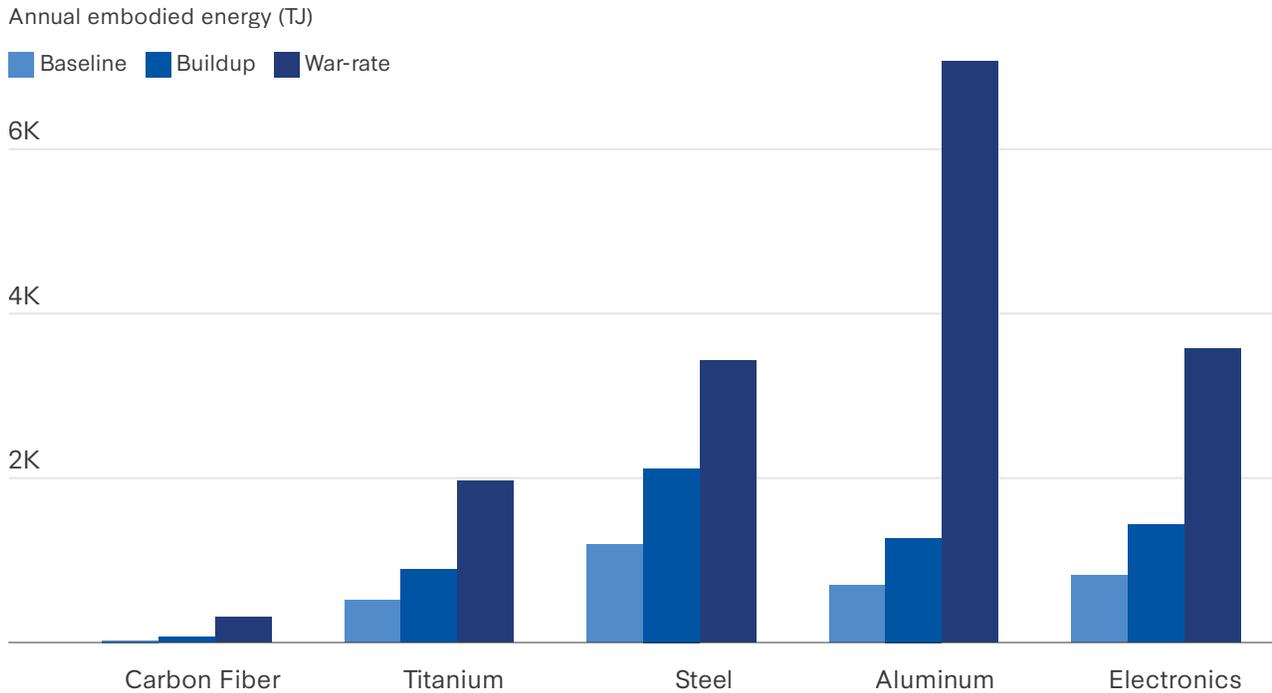
Source: CSIS.

the aggregate, has enough energy. However, differences across mobilization scenarios are substantial. Respectively, the buildup and war rate scenarios require 1.8 and 5 times more energy than estimated baseline production levels. While negligible nationally, the buildup and war rate scenario increases center on specific materials, enabling identification of both which materials drive consumption and which production facilities, and their associated regional grids, might face the greatest pressure under mobilization.

Figure 2 disaggregates war rate energy demand by material. Together, electronics (3,572 TJ), aluminum (7,068 TJ), and steel (3,428 TJ) account for 81 percent of total embodied energy, with titanium (1,968 TJ) and carbon fiber (309 TJ) comprising most of the remainder. Steel and aluminum demands reflect the mass (tonnage) requirements of naval vessels and armored systems. Titanium, despite its lower required tonnage, drives increases because of its relatively higher embodied energy. Electronics demand spans all platform categories, from guidance systems in munitions to avionics in combat aircraft, accounting for its large increases.

The scaling dynamics across mobilization scenarios differ markedly by material. Figure 2 illustrates how aluminum demand increased tenfold between the baseline mobilization scenario and war rate levels, roughly fourfold for electronics and titanium, and threefold for steel. This divergence is driven by which systems scale most aggressively under mobilization: Production demands related to expendable munitions and autonomous platforms increase much faster than those for large, crewed vessels.

Figure 2: Embodied Energy by Material Across Mobilization Scenarios



Source: CSIS.

A handful of systems are responsible for the jump in demand from the buildup to war rate scenarios. Foremost among those are unmanned surface vehicles known as modular autonomous surface craft (MASC), which account for nearly half of the combined electronics and aluminum increase, reflecting a shift toward distributed, attritable naval assets.¹ Precision-guided munitions—represented in the quantitative analysis by the JASSM and GBU-39 Small Diameter Bomb—drive much of the electronics surge because the war rate scenario assumes extremely high rates of production to meet the anticipated enormous demand for standoff weapons.

These increases reflect the U.S. military’s shift toward affordable mass and away from more traditional, long-lasting, but expensive and limited-number systems. That is, the U.S. military is increasingly focused on securing expendable, autonomous platforms produced in large numbers. Unlike traditional systems that would require new production lines and years of ramp up to increase numbers, production of these more affordable mass systems could surge more quickly, concentrating energy demand on electronics and aluminum production, potentially more quickly than energy infrastructure can keep up. The semi- or fully autonomous nature of these affordable mass systems means that all are characterized by a high density of electronics.²

REGIONAL VULNERABILITIES

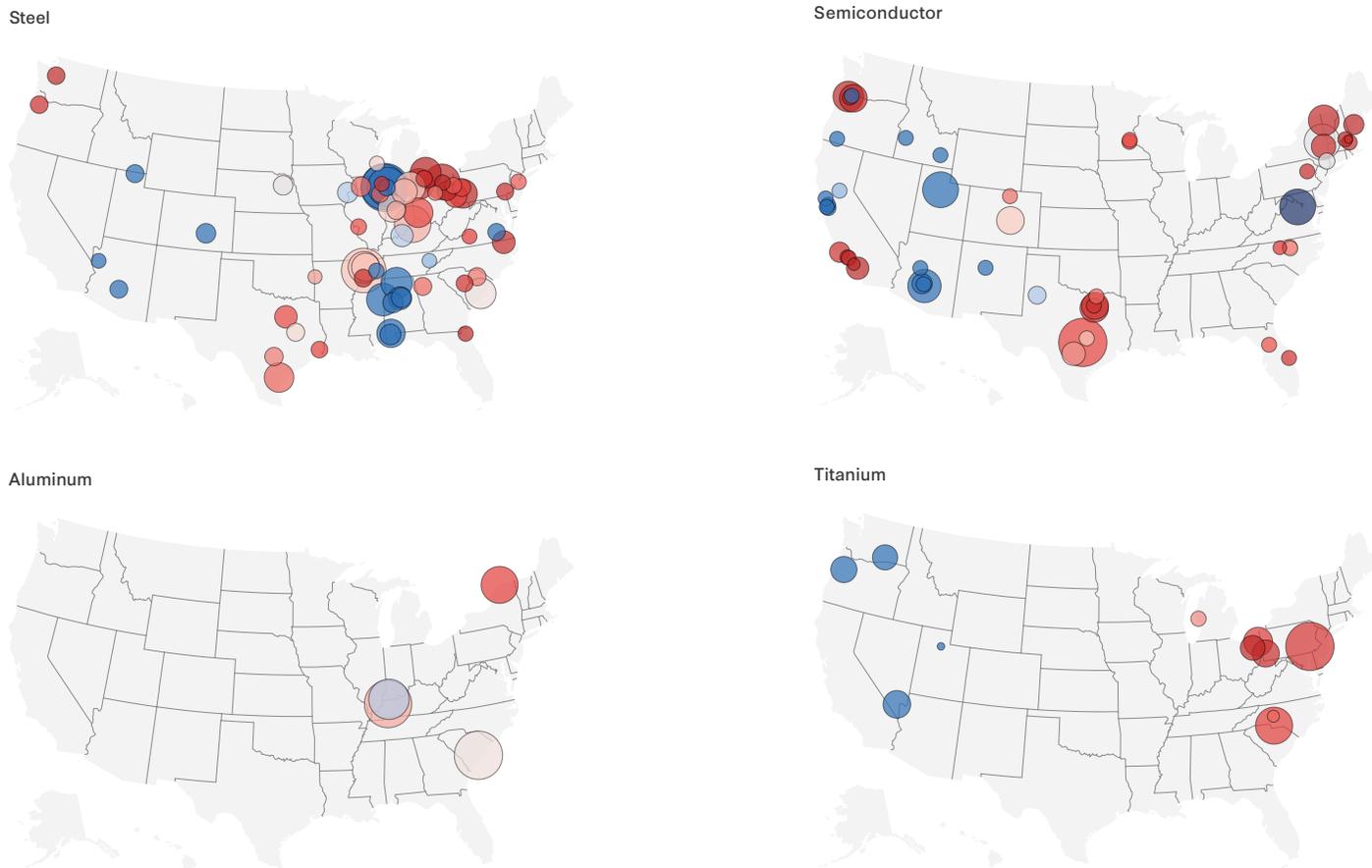
This section examines whether the energy infrastructure serving the defense industrial base can deliver. Identifying potential energy bottlenecks requires mapping material-specific demands onto regions housing the primary production facilities for aluminum, steel, titanium, and electronics manufacturing and then evaluating the energy constraints facing those regions.

The analysis focuses on two primary production constraints: electricity grid reliability and natural gas deliverability. Both matter—a grid outage can halt production regardless of gas supply, and a gas shortage can idle facilities even when the grid is stable. But during winter stress events, the two constraints interact: Pipeline bottlenecks limit fuel availability for gas-fired generation, weakening the grid precisely when electricity demand peaks.

The sources for the location of critical industrial facilities are listed in the annex.

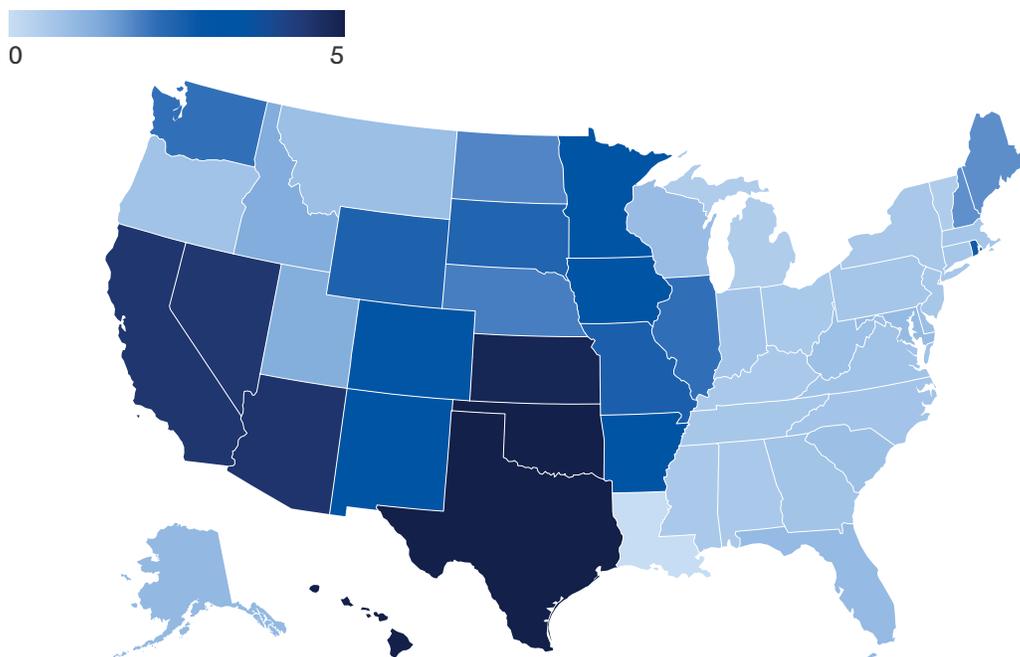
Figures 3 and 4 showcase two key dimensions of risk: grid reliability and gas deliverability. State backgrounds are shaded by winter gas price volatility, a proxy for gas deliverability constraints during peak demand periods. Facility points are colored by the **Power System Vulnerability Index** (PSVI), a county-level measure of grid reli-

Figure 3: Distribution of Critical Industrial Facilities by Sector



Note: Symbol size represents facility capacity.
Source: CSIS.

Figure 4: Winter Gas Price Volatility by Sector



Note: Color represents county-level power system vulnerability (PSVI).
Source: CSIS.

ability risk. The PSVI is a composite index measuring the frequency, duration, and intensity of county-level power system outages, while facility size reflects production capacity. As both figures demonstrate, critical industrial capacities cluster within regions facing elevated risk on one or both of the identified dimensions. The PJM Interconnection (PJM) is a regional transmission organization that manages the electrical grid for 13 states in the mid-Atlantic and Midwest. This region hosts the majority of U.S. titanium and aluminum production and, as Figures 3 and 4 illustrate, exhibits high PSVI scores but moderate gas volatility. The Electric Reliability Council of Texas (ERCOT), which manages the vast majority of Texas’ electrical grid, hosting nearly a third of U.S. semiconductor fabrication capacity, displays both high PSVI and high gas volatility.

The sections that follow examine each constraint in detail before assessing how they compound in tandem, and what the implications of this compounding could be for defense-critical industries.

ELECTRICITY GRID VULNERABILITIES AND CRITICAL INDUSTRY CONCENTRATION

The materials most critical to defense industrial applications are also those that face the greatest exposure to grid reliability risk. Of approximately 110 million tons of U.S. steel capacity, for example, **58 percent** is located in counties with medium-to-high PSVI scores in 2023. Titanium production shows the most acute concentration: 73 percent of domestic capacity sits in counties with PSVI scores above 75, with the facilities clustered primarily within the PJM Interconnection. Semiconductor fabrication capacity, driven largely by Texas facilities, has roughly 60 percent exposure to high-risk grid regions. The four

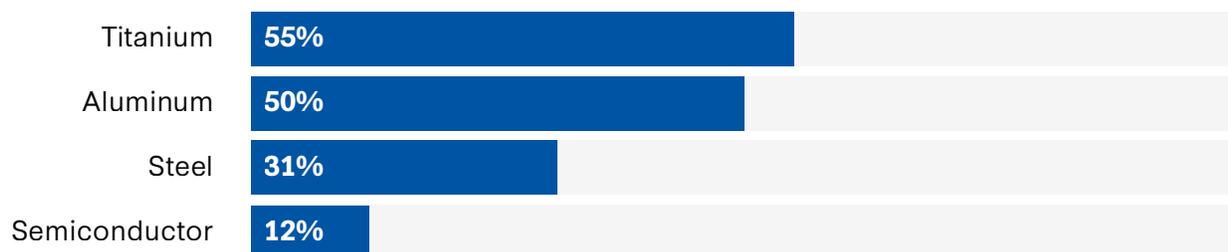
primary aluminum smelters in the United States all operate in medium-risk regions (Figure 3). This distribution of defense-critical industrial facilities means that the sectors with long reconstitution timelines and the most specialized production processes (i.e., titanium sponge, advanced logic chips, and military-grade aluminum) are located in grid regions that are poorly equipped to provide uninterrupted power supply.

Hosting 55 percent of U.S. titanium capacity, 50 percent of aluminum capacity, 31 percent of steel capacity, and 12 percent of semiconductor capacity, the PJM region exhibits particular geographic vulnerability. This concentration creates correlated failure risk: A single grid stress event could constrain multiple defense-critical supply chains simultaneously. Moreover, while PJM has historically been reliable, the region is facing a rapid deterioration in its ability to meet reliability standards. In its **2026 Long-Term Reliability Assessment**, for example, the North American Electric Reliability Corporation (NERC) identified PJM as a region of “elevated risk” for capacity shortfalls, adding that the area would reach “high risk” by 2029, with increases largely driven by demand growth and the expected retirement of generation capacity. For industrial consumers, this signals that the grid within PJM has little buffer left to absorb shocks and limited ability to grow production.

GAS DELIVERABILITY CONSTRAINTS

Limited natural gas transportation and storage infrastructure creates what could be described as a dual-exposure risk for key U.S. industries. Facilities like steel and titanium foundries rely on gas twice: first as a direct fuel for high-temperature smelting, and second as a primary fuel for the electricity grids that power their operations.

Figure 5: Distribution of Critical Industrial Capacity in PJM



Source: CSIS.

This twofold gas dependency is concentrated in major grid regions: the California Independent System Operator (CAISO), the Midcontinent Independent System Operator (MISO), PJM, the Southeastern Electric Reliability Council (SERC), and ERCOT, all of which relied on natural gas for **at least 40 percent** of their generation mix as of 2024.³ These five, gas-dependent regions also host the overwhelming majority of critical U.S. industrial capacity (Figures 3 and 4), including 97 percent of steel capacity, 84 percent of titanium capacity, 82 percent of aluminum capacity, and 57 percent of semiconductor capacity.

Consequently, when gas deliverability is constrained, manufacturers face a compounded crisis: direct fuel shortages for their furnaces alongside spiking prices for their electricity. A lack of adequate storage further mediates this risk, as insufficient storage capacity limits the ability of facilities and system operators to manage periods of peak demand when deliverability is constrained.

To determine and assess geographic variation in this risk, this analysis uses winter price-based volatility—calculated as the standard deviation of the difference between **Citygate prices** and the **Louisiana benchmark prices** over winter months (November to March) for the five-year period from 2019 to 2024—as a proxy for physical deliverability risks during peak stress periods.

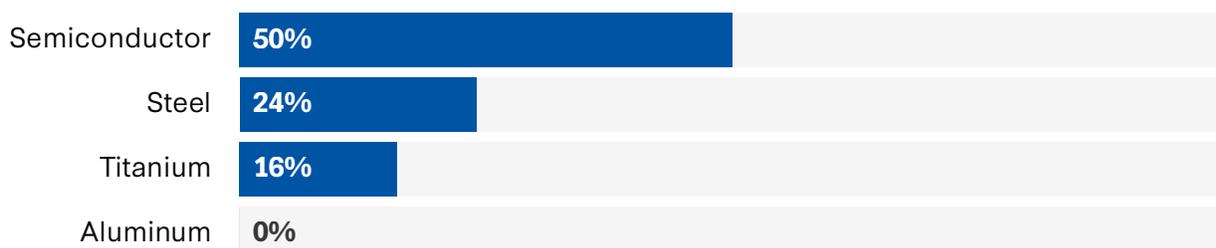
Applying this metric across states reveals a clear divergence in regional gas security. While the nationwide median winter-based volatility is relatively stable at \$0.94 per million British thermal units (MMBtu), the data in Figure 4 highlights instability in specific regions, with price volatility reaching as high as \$4.44/MMBtu, over 100 percent above the official benchmark for North American natural gas spot pricing, commonly referred to as the Henry Hub because it is the price of natural gas for immediate delivery at the Henry Hub in Erath, Louisiana. The highest volatility is clustered in the Southern Plains and

the Mountain West, indicating potential gas deliverability constraints. Oklahoma (\$10.47/MMBtu) and Texas (\$6.71/MMBtu) exhibit the most extreme decoupling from the benchmark, followed by Kansas (\$4.82/MMBtu), Arizona (\$4.47/MMBtu), and California (\$4.43/MMBtu).

Applying a threshold of \$2/MMBtu for winter-based volatility identifies a distinct “high-risk region” of 18 states, with Texas having the highest price volatility (Figure 4). This concentration of risk creates a disproportionate exposure for the semiconductor industry: 32 percent of U.S. fabrication capacity is also located within Texas. The implications here extend beyond fuel costs. Because high prices in these regions frequently signal physical deliverability constraints, fabs face the threat of abrupt fuel or power curtailments that can scrap millions of dollars in sensitive work-in-progress inventory, **as occurred in 2021**. In contrast, heavy metal production is slightly more secure; only 24 percent of steel and 16 percent of titanium capacity falls above the \$2/MMBtu threshold, while aluminum smelting capacity is entirely absent from the highest-risk regions.

The remaining critical industry capacity is primarily concentrated in PJM, where winter-based volatility averages approximately \$1/MMBtu, approximately 20 to 25 percent of 2024 Henry Hub prices. While prices have historically been less volatile in this region, deliverability risk remains. **Winter Storm Elliott** in December 2022, for example, triggered widespread gas production freeze-offs and pipeline pressure drops. This resulted in elevated gas prices throughout PJM and the activation of a variety of emergency procedures. Even in regions with moderate baseline volatility, deliverability constraints can rapidly escalate into systemic supply threats.

Figure 6: Critical Industrial Capacity Exposure to Winter Gas-Price Volatility



Source: CSIS.

COMPOUNDED EXPOSURE AND ITS IMPLICATIONS

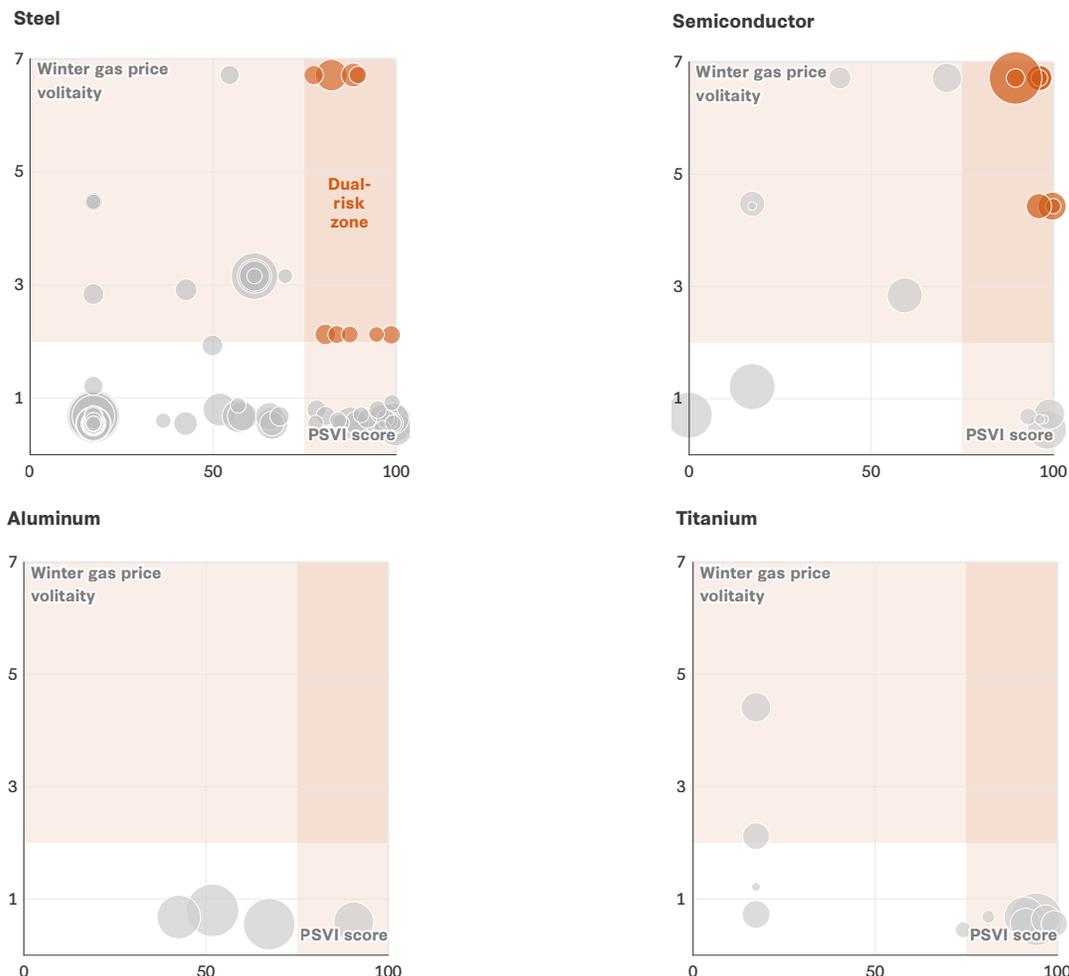
Neither grid reliability nor gas deliverability risk exist in isolation. This section examines where convergence across these risks occurs and the implications for defense-critical industrial facilities.

The dual-axis charts found in Figure 7 show the distribution of critical industries across PSVI and winter gas price volatility. Facilities with both high PSVI scores and high gas price volatility are located in the top right quadrant (red) of each industry chart.

Figure 7 plots each facility by its county-level PSVI score (x-axis) and state-level winter gas price volatility (y-axis), with bubble size proportional to capacity. Independently, both metrics indicate potential failure points: A high PSVI score reflects grid unreliability, while an elevated gas price volatility

number signals pipeline deliverability constraints. Together, the risks compound. During extreme winter events, regions with high gas price volatility face difficulty accessing supply both for electricity generation and for direct industrial use. Gas-fired power plants—which represent roughly half of ERCOT’s energy generation capacity and a significant share in MISO—compete for the constrained supply, weakening the grid precisely when demand peaks. Industrial facilities then face two simultaneous failure modes: an inability to procure natural gas directly and an elevated probability of electricity outage from a stressed grid. The shaded regions in Figure 7 mark thresholds for elevated risk on each axis; facilities in the upper-right quadrant face this compounded exposure. Twenty-seven percent of U.S. semiconductor fabs sit in counties with both high PSVI and elevated gas volatility, the majority of which are concentrated in ERCOT.

Figure 7: Critical Industry Facility Distribution Exposure Risks
Facility Distribution at the County (PSVI) and State Levels (Winter Gas Price Volatility)



Source: CSIS.

As a result, semiconductor fabs face the most acute dual exposure. Nearly half of U.S. fab capacity is located in high-PSVI counties, and another half is located in states with high gas volatility—with significant overlap of the two risk metrics in Texas. Semiconductor facilities have the longest reconstitution timelines in the industrial base; advanced fabs take years to build and require sustained, uninterrupted power to operate. Winter Storm Uri (February 13–17, 2021) demonstrated this vulnerability: Samsung, NXP, and Infineon were all asked to **shut down** fabrication facilities to preserve residential power supply. These forced shutdowns resulted in hundreds of millions of dollars in scrapped semiconductor wafers and weeks of lost production time, demonstrating how quickly the double-failure of gas and grid can paralyze the sector. Steel production shows a split risk profile. Roughly 14 percent of facilities face this dual exposure in ERCOT and western MISO, while a larger share—35 percent of total U.S. capacity—sits in high-PSVI counties in PJM and the Ohio Valley, but where gas volatility is lower.

Titanium and aluminum face electricity-dominant risk. Titanium production is the most concentrated: 73 percent of U.S. capacity sits in high-PSVI counties, predominantly within PJM, but only 16 percent of total capacity faces elevated gas volatility. Aluminum presents a similar profile. The four primary smelters all operate in moderate-to-high PSVI regions with low gas volatility exposure. However, these facilities have already demonstrated acute sensitivity to electricity market conditions. For example, Century Aluminum’s smelter in Hawesville, Kentucky—the largest producer of aluminum in North America—was **idled in 2022** when power costs tripled, resulting in a production halt of 9 to 12 months.

Table 2: Overall Energy Infrastructure Exposure by Sector

Sector	High PSVI Exposure	High-Gas Volatility Exposure	Dual Exposure	Grid Region
Semiconductors	48%	50%	27%	ERCOT
Steel	35%	24%	14%	ERCOT + PJM
Titanium	73%	16%	0%	PJM
Aluminum	18%	0%	0%	PJM

Source: CSIS.

These vulnerabilities are embedded in the current system under baseline demand conditions. Winter Storms Uri (2021) and Elliott (2022) and the resulting energy constraints and production decreases occurred during normal peacetime operations. Under the wartime scenarios presented here, energy demand could rise between 3- and 14-fold across the steel, titanium, electronics, and aluminum production industries. Higher demand would mean that facilities have to operate at higher capacity factors, drawing more power and more gas, pushing systems closer to their limits. The probability of hitting the failure points identified here will likely increase in these scenarios. The margin for error under mobilization is thin, and the infrastructure serving these facilities was not designed for surge conditions. Yet mobilization is not the only source of demand growth pressuring these systems. Data center expansion—driven by cloud computing and AI workloads—is adding substantial new load to the grid regions where critical industrial capacity is already concentrated, thus competing for the same transmission capacities, generation resources, and gas supplies that the defense industrial base may need to call upon.

DATA CENTER DEMAND AS ADDITIONAL GRID PRESSURE

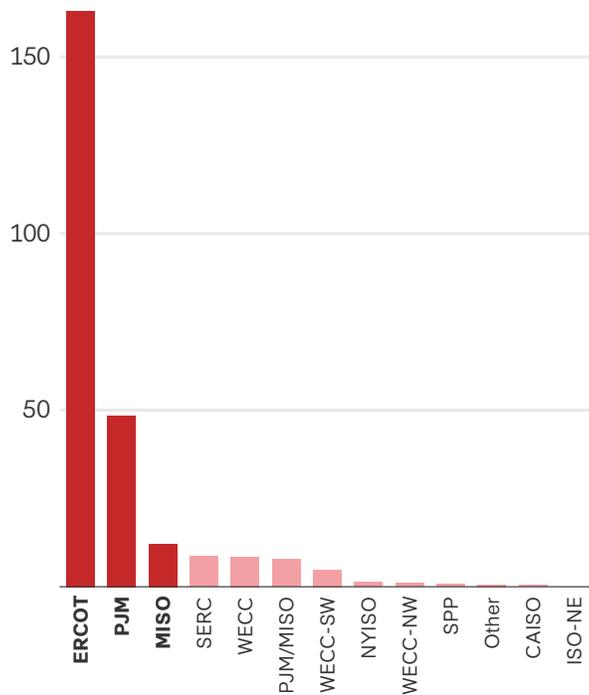
The energy vulnerabilities identified above reflect baseline conditions. However, the rapid growth and demand for AI technologies is adding additional pressure for limited energy resources, particularly in areas with critical industry concentration.

Figure 8 shows planned data center capacity by energy grid operators alongside the count of critical industrial facilities in each region.⁴ The scale is significant: ERCOT alone has 163.0 gigawatts (GW) of data center capacity in development, followed by PJM at 48.5 GW and MISO at 12.1 GW. To put this in perspective, PJM’s summer 2025 peak load was **161 GW**; planned data center additions represent roughly 30 percent of that peak.

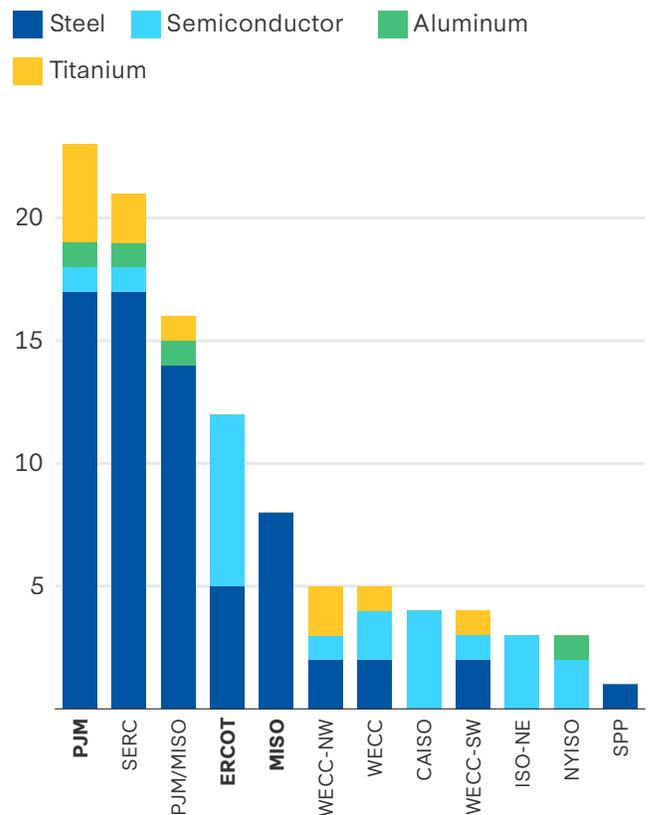
PJM, ERCOT, and MISO are the three grid regions with the highest planned data center capacity and the highest concentration of critical industrial facilities. PJM hosts 23 facilities across steel, semiconductors, aluminum, and titanium production, while also absorbing the second-largest amount (48.5GW) of data center growth. MISO supports 25 facilities, with 12.1 GW of data center development underway.

Figure 8: Planned Data Center Development and Critical Industry Concentration by Region

Planned data center capacity by ISO/RTO (GW)



Critical Industrial facility count by ISO/RTO



Source: Michael Thomas, “Data Centers in the United States,” Cleanview, updated March 2026, <https://cleanview.co/public/data-centers/us>; and “Dec 09, 2025 Board of Directors Meeting,” ERCOT, December 9, 2025, <https://ercot.new.swagit.com/videos/363073>.

ERCOT, already identified as a dual-risk zone for semiconductor fabrication, is slated to add 163 GW of new data center load. As Figure 8 illustrates, the grid regions facing the most significant electricity and gas vulnerabilities are also the regions absorbing the largest share of new data center demand.

This convergence creates cumulative pressure on constrained infrastructure. Both data center and industrial loads require high reliability and have limited ability to curtail their demand during grid stress events. Moreover, both draw on the same generation capacity, transmission infrastructure, and fuel supply. The challenge is not that these loads compete against each other for resources, but rather that grid infrastructure must accommodate both. Currently, that infrastructure is not materializing quickly enough. PJM’s interim CEO **acknowledged** in early 2026 that new generation capacity faces obstacles, including transmission upgrades, permitting, and supply chain bot-

tlenecks and that meaningful new capacity is unlikely to come online before 2032. The demand is arriving faster than the supply-side response.

Finally, the baseline demands against which any mobilization surge would occur are not static. In fact, demands are shifting upward as data center load comes online. The infrastructure decisions being made today—such as which projects clear the interconnection queue or which transmission lines get built—will determine whether capacity exists when it is needed.

POLICY IMPLICATIONS AND PATHWAYS FORWARD

The binding constraint on defense industrial energy resilience is not national energy supply. Instead, it is the speed at which key grid regions can add firm generation, transmission, and pipeline infrastructure to industrial clusters. In regions like PJM—where defense-relevant materials

production is concentrated—resource adequacy is quickly becoming a race between rising reliability needs and growing infrastructure timelines that now stretch into the next decade.

PJM illustrates these dynamics most acutely. The region hosts over 30, 50, and 55 percent of U.S. steel, aluminum, and titanium production capacity, respectively, much of it in high-PSVI counties. The infrastructure required to close this gap is not materializing at the necessary pace—interconnection timelines have stretched from **two to eight years**, gas turbine lead times now extend from **six to seven years**, and **46 GW of projects** with signed agreements remain unable to begin construction. These frictions are national: ERCOT faces similar capacity constraints, and MISO has flagged reliability risk in its northern regions.

Under the mobilization scenarios presented in this paper, energy demand for defense-critical materials could increase between two- and sixfold. Facilities producing titanium sponge, military-grade steel, and semiconductor components would draw more power from grids that are already capacity-constrained. Addressing these vulnerabilities requires action before a crisis materializes.

- **Recommendation 1: Extend defense-critical electric infrastructure designations to the industrial base.**

Federal law already provides a useful organizing concept: “**Defense Critical Electric Infrastructure**” (DCEI) refers to electric infrastructure that serves a critical defense facility but is not owned or operated by that facility—capturing the core dependency this paper identifies. The problem is that DCEI is currently applied almost exclusively to military installations, and the vulnerabilities documented here exist at non-military industrial nodes: titanium sponge facilities, aluminum smelters, steel mills, and semiconductor fabs, along with supporting specialized sub-tier suppliers. If energy is a regional constraint on wartime production, the Department of Defense (DOD) cannot treat industrial energy resilience as an undifferentiated grid problem. The DOD needs a process to determine which non-DOD facilities functionally behave like critical defense facilities in a mobilization scenario, and which upstream electric and gas assets constitute their outside-the-fence dependencies.

This makes supply chain illumination a gating step. The Government Accountability Office (GAO) documents **persistent difficulty** in acquiring sub-tier supplier information due to limited contractual requirements, and the DOD’s Defense Business Board emphasizes that most organizations lack visibility beyond prime contractors. If the DOD cannot reliably identify the sub-tier suppliers that produce defense-critical materials and components, it cannot credibly identify the energy infrastructure that must be secured to keep wartime production running.

There is concern with any such mapping effort that the existence of detailed information about defense-critical facilities and their infrastructure dependencies could create targeting risk. Here, existing law provides a solution. **Section 215A** establishes the **Critical Electric Infrastructure Information** (CEII) framework, jointly administered by the Department of Energy (DOE) and the Federal Energy Regulatory Commission (FERC), which provides statutory protection for sensitive infrastructure data. Information designated as CEII is explicitly exempt from disclosure under the Freedom of Information Act (FOIA) and cannot be released by any federal, state, or local authority under public disclosure laws. The CEII framework also facilitates voluntary sharing of protected information among federal agencies, state authorities, regional transmission organizations, reliability coordinators, and owners and operators of critical infrastructure—all under non-disclosure agreements that restrict use to specified purposes.

- **Recommendation 2: Create a dedicated permitting and finance pathway for energy assurance at designated industrial facilities.**

Once identified as defense-critical production facilities, energy upgrades by those fabs cannot be treated as ordinary infrastructure projects, as doing so will create a mismatch between stakes and timelines. Building additional infrastructure is necessary, but doing so at the speed demanded to meet mobilization demand will require permitting and financing incentives to catalyze capital. Two existing federal authorities provide the foundation for potential implementation pathways.

Title III of the Defense Production Act authorizes direct federal investment to create, expand, or restore industrial base capabilities essential to national defense. The DOD has already used Title III to address capacity constraints throughout the defense supply chain: \$23 million to Constellium for aluminum casting capacity, \$45.5 million to Arconic for high-purity aluminum production, and \$90 million to Albemarle for domestic lithium mining. In 2022, President Biden issued a **determination authorizing** Title III for transformers and electric grid components. In 2023, the statutory investment ceiling was **waived** for supply chains including power and energy storage.

Title III funds can and have been deployed in a variety of manners, including direct loans, loan guarantees, purchase orders, grants, and subsidies. These financing instruments can help address the rising costs of construction, private capital, and inflation that energy generation and infrastructure developers are facing.

However, existing federal permitting processes are not yet designed to treat energy infrastructure upgrades at industrial nodes as time-sensitive national security investments. Projects that would improve power supply to defense-critical facilities compete in the same interconnection queues and face the same siting disputes as routine commercial development. Moreover, EISA 2007 Section 433 mandates the elimination of on-site fossil fuel consumption in new and substantially renovated federal buildings by 2030. While industrial process loads are exempt, building operational systems at DOD-owned manufacturing facilities, such as shipyards or ammunition plants, remain covered. The implementing regulation is currently stayed, but it could delay energy upgrades under a mobilization scenario if reimplemented. A dedicated pathway could expedite permitting for generation, transmission, and pipeline projects that directly serve designated defense-critical facilities. Such a pathway should also clarify the applicability of Section 433 to DOD-owned industrial facilities, ensuring that fossil fuel restrictions do not impede energy upgrades critical to mobilization. The model here is analogous to the expedited environmental review

processes that already exist for military construction projects under **10 USC § 2801**, adapted for the civilian energy infrastructure on which defense production depends.

■ **Recommendation 3: Integrate energy resilience into defense supply chain risk assessments.**

The vulnerabilities identified in this paper arise from the interaction of two systems that are currently assessed in isolation: the defense supply chain and the energy grid. The DOD's supply chain risk management frameworks evaluate material availability, supplier concentration, and foreign dependency, but not whether the energy infrastructure serving domestic suppliers can sustain production under stress. Conversely, grid reliability assessments by regional transmission organizations and NERC evaluate system adequacy in aggregate but do not account for the defense-criticality of specific industrial loads in their analyses.

Bridging this gap requires adding energy infrastructure metrics to the criteria that the DOD uses to assess supply chain risk. At a minimum, this would mean incorporating grid reliability data (such as PSVI scores or NERC reliability assessments) and gas deliverability indicators into the risk profiles maintained for critical suppliers. More ambitiously, addressing this gap could involve joint planning exercises between the DOD, DOE, FERC, and regional transmission organizations to stress-test energy supply to defense-critical industrial clusters under mobilization scenarios. The regional energy resilience exercises that the DOD already conducts for military installations could be extended to encompass the industrial nodes on which those installations depend. Such exercises would identify specific infrastructure investments—such as a transmission upgrade here, a pipeline lateral there, or on-site generation at a critical facility—that would materially reduce the probability of energy-driven production interruptions during a crisis.

CONCLUSION

The United States has enough energy to power a wartime industrial mobilization. What it potentially lacks, however, is the infrastructure required to deliver that energy to the

places where it is needed. This paper has shown that the binding constraint on defense industrial energy resilience is not national supply but rather regional delivery: the capacity of specific grid regions and pipeline networks to serve the production facilities on which the defense industrial base depends.

The geography of this risk is not random. Critical materials production concentrates in PJM and ERCOT—regions facing eroding reserve margins, gas deliverability constraints, and surging data center demands. Under mobilization, energy demand could increase two- to sixfold, pushing infrastructure not designed for surge conditions closer to failure.

World War II taught the United States that energy constraints on wartime production are foreseeable and preventable, but only if the government acts before a crisis materializes. During the interwar period, the War Department’s power surveys, construction controls, and power pooling mandates prevented the energy shortfalls that had hampered production in World War I from repeating in World War II. In 2026, the tools are different, but the principle is the same: Identify where energy infrastructure and defense production intersect, and invest in closing the gaps before they bind the system. The recommendations in this paper—extending defense-critical infrastructure designations to the industrial base, creating dedicated permitting and finance pathways, and integrating energy resilience into supply chain risk assessments—represent a first step toward that end. The infrastructure decisions made now will determine whether the United States can produce what it needs, when it needs it, and at the scale a serious conflict would demand. ■

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ENDNOTES

- 1 This analysis did not model unmanned underwater vehicles because they were not included in the Navy's most recently published shipbuilding plan. Data on these systems is extremely scarce in open sources.
- 2 While long-range precision munitions are rarely thought of as autonomous systems, they are distinguished from "dumb" munitions in part by their on-board processing power. Despite the recent emergence of public debate on the risks of military autonomy, cruise missiles have been able to steer themselves around obstacles since the 1970s and to automatically recognize targets using onboard cameras since at least the 1980s.
- 3 CAISO manages the grid for most of California. MISO spans a north-south corridor from Manitoba and the Upper Midwest (Minnesota, Wisconsin, Michigan, Indiana, Illinois) down through the mid-South (Arkansas, Mississippi, Louisiana). PJM covers the Mid-Atlantic and parts of the Midwest, including all or parts of 13 states from Illinois east to New Jersey and Virginia, plus the District of Columbia. SERC encompasses much of the Southeast (the Carolinas, Georgia, Alabama, Tennessee, and parts of surrounding states). ERCOT operates the grid for roughly 90 percent of Texas's electric load.
- 4 Roughly two-thirds of U.S. electricity consumers are served by energy grid consumers that are either Independent System Operators (ISOs) or Regional Transmission Organizations (RTOs).