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To win the AI race, the US needs an all-of-the-above energy strategy

About This Brief

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The Atlantic Council Global Energy Center develops and promotes pragmatic and nonpartisan policy solutions designed to advance global energy security, enhance economic opportunity, and accelerate pathways to net-zero emissions.

Introduction

The United States faces a "Sputnik moment."[1] Chinese firm DeepSeek claims its artificial intelligence (AI) model has achieved near-parity with US models in terms of functionality—at lower cost and energy use.[2] While many AI analysts are skeptical of some portions of DeepSeek's claims, particularly surrounding cost nuances,[3] or even its ability to lower energy consumption,[4] virtually all acknowledge that DeepSeek has made a serious technical achievement.[5] Even as firms across the chip making, energy, and technology sectors sort through the implications, DeepSeek's technical breakthrough will intensify the US-China AI race, with significant economic and military stakes. Staying ahead will require the United States to tighten chip export controls, increase investment, train an AI-relevant workforce, and collaborate with allies and partners across Europe, the Indo-Pacific region, the Middle East, and elsewhere. Additionally, and while acknowledging uncertain AI-related energy demand,[6] the United States must build substantial amounts of new electricity generation and transmission to win the AI competition with China.

To ensure US AI leadership, the United States must harness all forms of energy, allow a level playing field, and remove red tape constraining the build-out of critical enablers, especially transmission lines and grid-enhancing technologies. A "some of the above" energy approach could force the United States to compromise on not only AI leadership but also affordable electricity and other economic priorities. Failing to obtain sufficient electricity from all sources would stymie the push for US manufacturing. Constraining US access to all forms of energy—a some of the above strategy—would force scarce natural gas molecules into the power market, constraining liquefied and pipeline natural gas exports and sending the US trade deficit even higher; raise domestic energy prices; and make US manufacturing less competitive.

The AI race with China carries high stakes. If the Chinese Communist Party can achieve global technological dominance via AI, it is unclear where or if General Secretary Xi Jinping's ambitions will stop, given his deeply held belief in total ideological control.[7] China's leadership in AI would pose disasters for the world, not only because of Xi's ideology but also the Chinese Community Party's seemingly devil-may-care approach to technological risks[8] and mismanagement of crises,[9] including by failing to adequately warn the world of dangers as COVID-19 emerged.

The competition with China in artificial intelligence may be the defining national security challenge of our time. To win this all-important race, the United States must mobilize its resources, including in energy.

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Powering US artificial intelligence

The AI race's impact on energy demand is uncertain. Advances like next-generation chips and DeepSeek's breakthrough may boost efficiency,[10] yet most estimates hold AI could still drive electricity consumption higher.[11] Indeed, some analysts believe that DeepSeek's breakthrough will necessitate even more electricity usage.[12] In any event, the United States will likely need significant new power generation, especially since data center demand is due to not only artificial intelligence but also traditional cloud computing requirements. Global data center-critical IT power for non-AI purposes is expected to grow more than 50 percent from 2022 levels by 2028.[13]

Artificial intelligence requires data centers' computational power, storage, and low-latency networking—and the attendant electricity demands. For reference, a traditional Google search requires 0.3 watt-hours of electricity; a Chat-GPT query needs 2.9 watt-hours.[14] Given these dynamics, the Electric Power Research Institute (EPRI) finds that data centers' electricity needs will grow somewhere between 3.7 percent and 15 percent every year.[15] In the highest-growth scenario, EPRI estimates that data centers will account for about one in eleven electrons consumed on the US grid by 2030, up from about 4 percent in 2023.[16] Due largely to data centers (for both AI and traditional cloud computing needs) and manufacturing,[17] overall US electricity demand may grow by 15.8 percent by 2029,[18] according to Grid Strategies—a departure from the prior decade's flat electricity consumption.[19]

Furthermore, incremental electricity demand for data centers will be highly localized and concentrated in just a few states. Virginia, home to what's dubbed Data Center Alley in northern Virginia, the single most important data center hub in the United States. EPRI finds data center demand in Virginia reached nearly 34 terawatt hours (TWh) in 2023, accounting for 26 percent of all state electricity consumption.[20] Virginia's data center electricity use in 2023 exceeded the combined demand of data centers across Texas and California.

To power data center electricity needs in the United States, an all-of-the-above energy strategy is needed, leveraging the country's natural gas resources, particularly in the short term, but also other energy supplies as they are constructed and connected to the grid, and as transmission systems are upgraded and expanded.

AI and electricity: Natural gas can partially meet demand

The United States enjoys abundant natural gas reserves that can help partially power AI's electricity needs. Natural gas is, fortunately, substantially cleaner than coal when burned in the power sector,[21] and many producers have pledged to reduce methane emissions from flaring and venting.[22]

Yet despite its economic and environmental appeal over coal, US AI can only be partially fueled by natural gas. Oil and gas production is unlikely to surge even in the new permissive regulatory environment. Investors are imposing capital discipline on US oil and gas companies and often punishing expanded production.[23] The energy consultancy RBN predicts US dry natural gas production will rise 1.9 billion cubic feet per day (Bcf/d) in 2025, barely exceeding the 1.6 Bcf/d it expects in new liquefied natural gas (LNG) export capacity over the same period.[24] Similarly, the US Energy Information Administration (EIA) projects US total growth in natural gas demand will

exceed total supply growth by 1.8 Bcf/d in 2025 and by 0.1 Bcf/d in 2026.[25]
With their output constrained, US producers will struggle to meet demands from domestic consumption, as well as LNG and pipeline exports. Significantly, natural gas prices are expected to nearly double from 2024 to 2026, despite projections of declining electricity sector demand.[26] If the natural gas power sector consumption rises, however, benchmark prices could more than double, harming LNG and pipeline export competitiveness.

Electricity-directed natural gas infrastructure also faces midstream and downstream constraints. Tariffs could raise steel prices, making new-build pipelines costlier,[27] while limited turbine availability for new power plants will delay projects.[28] Indeed, Evergy just announced two Kansas combined cycle plants that won't open until 2029/2030,[29] and Indiana's 2030 turbine costs have doubled vs. a 2022 Michigan plant,[30] as investor John D. Arnold pointed out.[31]

Further complicating the prospects for using natural gas to power data center growth are the constraints of regional natural gas markets. A prime example of this is the Pennsylvania side of the Marcellus Basin, near northern Virginia's Data Center Alley, where well productivity dropped 7 percent in 2022,[32] despite a spike in prices from Russia's invasion of Ukraine.[33] By December 2024, basin-wide production of shale dry gas production fell 1.8 Bcf/d from December 2023 levels.[34]

Marcellus Basin production could certainly expand in a more permissive regulatory environment, especially if pipeline takeaway capacity constraints are eased.[35] But with natural gas analysts warning even in January 2025 of significant commercialization challenges,[36] Marcellus production is unlikely to see liftoff.
The Permian Basin in West Texas has the potential to supply natural gas for nearby AI use, but also faces limitations from competition with exports and pipeline constraints. The Permian Basin's dry natural gas output rose to 19.9 Bcf/d in December 2024, up from 17.8 Bcf/d in the prior year, due not only to growing in-basin crude oil production (and associated gas) but also higher gas-to-oil ratios.[37] Moreover, in-basin regional data centers' proximity leads to less flaring,[38] making US LNG more attractive to EU buyers targeting net-zero emissions by creating demand for molecules that would otherwise be flared or vented.[39]

Still, it's unclear to what extent Permian Basin natural gas can supply additional data centers along north Texas's I-35 information technology corridor, home to a substantial number of data centers,[40] due to pipeline constraints. Three approved Texas pipeline projects have a total capacity of 7.3 Bcf/d,[41] but are all export-directed, delivering volumes to Mexico, South Texas, and the Louisiana border, with the US-directed pipelines expected to arrive in 2026. Additionally, Permian natural gas production is typically a byproduct of oil prices. Therefore, if greater OPEC oil production decreases oil prices, less oil and natural gas will be produced in the Permian Basin, all things being equal. In sum, natural gas will play a role in meeting artificial intelligence demand. Still, it will be difficult to both power the AI boom and reduce US trade deficits via exports of LNG or pipeline natural gas at the same time.

Could coal power AI?

Rising AI demand may delay some coal plant closures to protect grid reliability and US AI security. Beating China in AI outweighs shutting down a few US coal plants, especially since China, the world's largest producer, importer, and consumer of coal,[42] consumes more coal than the rest of the world combined.[43] Still, coal won't power US AI.

Even ignoring climate concerns, natural gas and advanced energy technologies like wind, solar, and storage, are more economical than coal in most parts of the United States. Due to the US shale revolution, natural gas has overtaken coal as the leading provider of baseload fuel.[44] Moreover, according to a 2023 analysis by Energy Innovation,[45] 99 percent of existing coal plants are more expensive to run than replacement by advanced energy sources such as wind, solar, and storage. Without accounting for the incentives of the US Inflation Reduction Act—or technological innovations since the study—an analysis from 2021 found that 80 percent of the US coal fleet could be replaced by wind and solar—with immediate savings.[46] Tech firms, bound by climate commitments and reputational risks, will avoid coal. In polling from 2023, Americans favored discouraging coal mining over encouraging it by 18 points.[47] Coal is not going to power US AI.

Powering US AI requires an all-of-the-above strategy

Meeting AI's power demand requires more than natural gas and coal. The United States will need to expand advanced energy technologies such as solar, batteries, grid-enhancing technologies, wind, geothermal, and nuclear energy, which are best positioned to meet increasing US electricity needs. Key steps for leveraging these energy sources include accelerating transmission line approval processes, clearing interconnection queues, and cutting red tape, especially in the PJM market of thirteen states and the District of Columbia,[48] which services the United States' most important data center cluster. To remain competitive with China in the AI race, policymakers should prioritize solar, batteries, and grid-enhancing technologies while supporting other energy sources.

Solar, paired with battery energy storage (BESS), is often the fastest and most cost-competitive way to expand US power generation.[49] Once permitting hurdles are cleared, utility-scale solar can be built in twelve to eighteen months,[50] with over half of US solar projects already integrating BESS.[51]

Solar is an especially attractive option for US AI energy needs due to its ability to rapidly deploy on rooftops near data center clusters. Rooftop solar is typically the fastest means to add electrons to the grid: Residential solar installations take weeks,[52] while more complex commercial projects take months, not years. However, rooftop solar isn't a panacea—it uses fixed panels that can't track sunlight,[53] leading to lower capacity factors,[54] especially in winter. Still, rooftop deployments could quickly add gigawatts of capacity. Bipartisan legislation at the national, state, and local levels should ensure that US AI has access to rooftop solar in northern Virginia's Data Center Alley and other data center clusters.[55]

Grid-enhancing technologies can also quickly boost US power transmission capacity. Advanced carbon-fiber wires can increase existing line capacity through reconductoring,[56] while dynamic line ratings (DLR) enable safer maximization of wire capacity by providing precise thermal limit data.[57] Both solutions can be implemented rapidly, with reconductoring projects typically completed in just eighteen months to three years.[58]

Geothermal energy, which is gaining momentum, also offers reliable baseload power ideal for data centers' uninterruptible power needs. It is potentially economically viable across much of the western United States.[59] Due to the success of the private sector, enhanced by support from the Department of Energy's Loans Program Office, new geothermal capacity is expected to come online in 2026.[60]

Geothermal for AI does have limitations. Many of the sites with the best technoeconomics are located far from population centers and will require new transmission lines or suffer from significant latency for consumer-facing AI applications (although these sites can be used to support training AI, which holds lower latency requirements).[61] Additionally, the private sector may have difficulty scaling up this technology without support from the federal government. Still, geothermal is a highly promising technology.

The semi-baseload properties of offshore wind, owing to its high-capacity factors,[62] render it a highly suitable technology for powering US AI, especially along the Atlantic coast. Latency-intensive applications will require data centers near dense populations, relying on local power—especially semi-baseload wind. In Virginia, semi-baseload wind's proximity to Data Center Alley supports US AI efforts, as seen in its bipartisan support from state leaders, including Governor Glenn Youngkin.[63] Semi-baseload wind is also highly useful for the Northeast due to this US region's high population and AI demand density; constrained gas market; challenging onshore construction environment; and mature wind-resource base, including for the offshore segment.

Importantly, the semi-baseload wind sector strengthens maritime national security and aligns with the bipartisan Shipbuilding and Harbor Infrastructure for Prosperity and Security for America Act (SHIPS) Act.[64] Offshore wind vessels' use of heavy plate steel is leading to more investment in the shipbuilding supply chain,[65] including a $110 million investment in a steel plate mill in Baytown, Texas.[66] Though in its early stages, the sector has already demonstrated billions of investments in US steel and shipbuilding, highlighted by the 472-foot Charybdis, America's first wind turbine installation vessel.[67] The Charybdis will service the largest semi-baseload wind project under construction in the United States, remains on-budget and on schedule, helping install 2.6 gigawatts of high-capacity factor electricity for the Data Center Alley Grid by 2026.[68]

Nuclear energy is an important technology for meeting AI's electricity needs but will have limited near-term impacts. While nuclear energy projects hold substantial appeal and are a necessary part of resourcing future US electricity needs (including items like military microgrids),[69] the technology has long development lead times and is highly sensitive to the cost of capital.[70] Additionally, tariffs on steel and other products could significantly impact nuclear energy project economics.

For each of these supply-side technologies, including natural gas, electricity transmission reform is critical. To move electrons on the grid, the United States must reform Biden-era roadblocks that inhibited American energy production and transmission. Take the PJM electricity market, home to the all-important Data Center Alley. In PJM, most projects entering the interconnection queue will be unable to come online before 2030,[71] undermining both US AI and national security objectives. The bipartisan permitting reform bill started by Senator John Barrasso and retired Senator Joe Manchin, while moribund, may be a useful starting point for ensuring US AI has the electrons it needs.[72]

Demand-side management

As critical as unlocking energy supply will be for US AI, policymakers should continue to incentivize development of technologies and practices that will deliver performance while reducing overall energy demand. One such potential practice is distributing training between many smaller data centers,[73] instead of large-scale computing clusters. Still, increased efficiency does not necessarily mean that AI will require less electricity. Instead, the Jevons Paradox holds that greater efficiency might result in overall increased demand for the resource.[74] Other demand-management solutions—such as reducing sources of unnecessary electricity consumption, especially around data center clusters—should also be a focus of policymakers. Greater efficiency would allow the United States to improve the productivity of existing AI resources, enabling it to better compete with China.

Winning the AI race

The US-China AI race demands a strategic approach to electricity. While AI's exact electricity needs remain uncertain, substantial power infrastructure expansion and efficiency improvements are needed. By building new generation capacity, enhancing transmission, and optimizing power consumption, the United States can maintain its competitive edge in AI development. Resourcing US energy needs will require all forms of energy. If the United States adopts a "some of the above" approach to energy, however, it will be waging the century's most important technological fight with China with one hand tied behind its back.

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